

18.2d
TRANSACTIONS,

OF THE

A M E R I C A N

PHILOSOPHICAL SOCIETY,

HELD AT

PHILADELPHIA,

FOR PROMOTING

USEFUL KNOWLEDGE.

VOLUME I.

From JANUARY 1st, 1769, *To* JANUARY 1st, 1771.

P H I L A D E L P H I A :

Printed by WILLIAM and THOMAS BRADFORD, at the
London Coffee-House.

M.DCC.LXXI.

TRANSACTIONS

OF THE

AMERICAN

PHILOSOPHICAL SOCIETY

Jos: Banks

FOR PROMOTING

USEFUL KNOWLEDGE

VOLUME I

NEW YORK: J. VAN NOstrand, 1837.

PRINTED BY J. VAN NOstrand, 1837.





ADVERTISEMENT.

TH E promoting useful Knowledge in general, and such branches thereof in particular, as may be more immediately serviceable to the British Colonies, being the express purpose for which the AMERICAN PHILOSOPHICAL SOCIETY was instituted; the Publication of such curious and useful Papers, as may, from time to time, be communicated to them, becomes, of course, one material part of their design.

As soon, therefore, as the Society judged that they had received a sufficient Number of Communications for a Volume, they appointed a Committee, to assist the Secretaries, in selecting out of them such as might be most proper for the public view. And for their direction in the execution of this trust, the two following Rules were given, viz.

First, " THAT the grounds of the Committee's choice of Papers for the Press, should
" always be, the importance or singularity of

“ the subjects, or the advantageous manner of
“ treating them, without pretending to answer,
“ or to make the Society answerable, for the
“ certainty of the facts, or propriety of the
“ reasonings, contained in the several Papers
“ so published, which must still rest on the
“ credit or judgment of their respective
“ Authors.

Secondly, “ THAT neither the Society,
“ nor the Committee of the Press, do ever
“ give their opinion as a body, upon any
“ paper they may publish, or upon any sub-
“ ject of Art or Nature that comes before
“ them.”

THESE Rules were adopted from the Rules of that illustrious Body the ROYAL SOCIETY of London, whose example the AMERICAN PHILOSOPHICAL SOCIETY think it their honor to follow, in their endeavours for enlarging the Sphere of Knowledge and useful Arts. And though, in Countries where the Arts and all useful Improvements have arrived almost at their maturity, the following WORK may scarce be considered as a mite thrown into the common treasury; yet here, where they are but in their infancy, it may be received as some accession to our smaller Stock.

L A W S A N D R E G U L A T I O N S,

O F T H E

American PHILOSOPHICAL SOCIETY,

Held at *PHILADELPHIA*, for promoting

U S E F U L K N O W L E D G E.

T W O Societies having formerly subsisted in Philadelphia, whose views and ends were the same, viz. "*the Advancement of useful Knowledge*"---it was judged that their Union would be of public advantage; and they were accordingly united *January 2d, 1769*, by a certain FUNDAMENTAL AGREEMENT; the chief ARTICLES of which are-----

First, THAT the name of the *United Society* shall be *The American Philosophical Society, held at Philadelphia, for promoting useful Knowledge.*

Secondly, THAT there shall be the following Officers of the Society, viz. one PATRON, one President, three Vice-Presidents, one Treasurer, four Secretaries, and three Curators.

Thirdly,

Thirdly, THAT all the above Officers shall be chosen annually by ballot, at the first meeting of the Society in January ; excepting only that instead of electing a Patron, the Governor of the Province be requested to be PATRON.

OTHER LAWS were to be made by the *United Society* ; and accordingly the following LAWS, &c. were passed *February 3d, 1769.*

I. *Of the annual payments to be made by Members.*

EVERY Member of this Society shall subscribe *Ten Shillings* yearly, to be applied by the Society to such purposes as they shall direct ; and no Member shall be entitled to a vote in the annual Election of Officers, unless it appears that he has paid into the hands of the Treasurer, the subscription of the preceeding year, and all former arrears, if any there were.

EVERY Member hereafter to be chosen, agreeable to the Laws of this Society, shall pay *Ten Shillings* admission money, and also subscribe for the yearly payment of *Ten Shillings*, before he is entitled to have any vote in the business of the Society at their meetings.

II. *Of the election of Members.*

THE ELECTION of new Members shall be by *Ballot*, and that only on the third Friday in the months of January, April, July and October ; and in order to such election at least twenty Members must be present.

ANY

ANY Member may, at any meeting, propose such person or persons, as he thinks proper to be a Member or Members of this Society; but no person shall be ballotted for, unless his name, together with the name or names of the Member or Members who proposed him, has been fixed up by the Secretaries for the view of the Society, at the two meetings preceeding the time of election. Nor shall any person be deemed duly chosen unless three-fourths of the votes of the whole Members be in his favour.

III. *Of the Officers, and manner of their election.*

THE election of such Officers as are to be chosen in this Society, shall be on the first Friday in January every year, by ballot or written ticket, between the hours of Two and Five in the afternoon, at such place in this city as shall be fixed by the Society at their previous meeting on the third Friday in December every year; of which notice shall be given in the Gazette, or such other public Papers as the Society shall order, at least one week before the day of election.

BEFORE opening the election, the company that shall be met at half an hour after Two, shall appoint three Members of the Society as judges of the election, and also two clerks or secretaries, for taking down the names of the voters. And in case of an equality of votes for any Officer, after casting up the ballots, the decision shall be by lots, to be drawn by one of the judges.

IV. *Of*

IV. *Of the President.*

THE President is to preside at all meetings, to preserve order, to regulate the debates, and to state and put questions, agreeable to the sense and intention of the Members.

V. *Of the Vice-Presidents.*

IN the absence of the *President*, his duty shall devolve on the *Vice-Presidents*, so that they shall preside alternately at meetings. But if the *Vice-President*, whose turn it is to preside at any meeting, should be absent, his place shall be supplied by any of the other *Vice-Presidents*, who shall be present, according as he may be next in turn. If only one *Vice-President* be present, he shall of course preside ; and if neither the *President*, nor any *Vice-President* be present, the Members met, shall appoint one of their number to take the chair for that meeting.

VI. *Of the Treasurer.*

THE *Treasurer* shall receive the subscriptions of the Members, and all other monies that may become due to the Society, and shall pay the same agreeable to their orders, certified to him by the *President*, *Vice-President* or Member, who was in the *Chair* when the order was made. The *Treasurer* shall keep a regular account of all monies received and paid by him as aforesaid ; and once every year, or oftner if required by the Society, he

he shall render an account to them of the stock in his hands, and the disbursements made by their order, and shall deliver up to his successor the books and all papers belonging to them, together with the ballance of cash in his hands. And for the faithful discharge of his trust, he shall, before he enters on his office, give bond and security to the President and Vice-Presidents, in double the sum which they, or any three of them, shall judge he may probably become entrusted with, during his said office.

VII. *Of the Secretaries.*

THE SECRETARIES shall so settle matters as to take equal shares of all business, and so as that two of them shall serve at every meeting, viz. one to take the minutes, and one to read all letters and papers that may be communicated to the Society. It is also the business of the two Secretaries of each particular meeting, to copy into the minute book the proceedings of that meeting, in order to produce the same fair to the next meeting. They are further to copy into the proper books all such letters, papers and essays, as the Society may think fit to preserve on record, and to have the same ready to be laid before the next meeting.

THE other two Secretaries are, in the meanwhile, to give notice to new members of their election, and agreeable to the directions of the Society,

Society, to write or answer letters; and, in general, to *manage all matters of Correspondence.*

THE Secretaries may, for their own ease, change places; so that the two who have served as *corresponding Secretaries*, for one month or limited time, shall take their turn to serve for the like time as *sitting or attending Secretaries.*

VIII. *Of the Curators.*

THE business of the CURATORS shall be to take charge of, and preserve, all *Specimens of natural Productions*, whether of the ANIMAL, VEGETABLE or FOSSIL Kingdom; all Models of Machines and Instruments, and all other matters and things belonging to the Society, which shall be committed to them; to class and arrange them in their proper order, and keep an exact list of them, with the names of the respective donors, in a book provided for that purpose; which book shall be laid before the Society, as often as called for.

THE Curators, on entering upon their office, shall give such a receipt for every thing that is committed to their charge, as the Society shall think proper; and, at the end of their term, shall deliver up the same to their successors. For the faithful performance of their duty, and of the trust reposed in them, they shall give bond to the Presidents, and Vice-Presidents, in such a sum as they, or any three of them, shall require.

IX. *Of*

IX. *Of the Meetings of the Society.*

THE ordinary Meetings of the Society shall be on the first and third Fridays of every month, from October to May, both inclusive, at Six o'clock in the evening, and on the third Friday in each of the other four months at Seven o'clock.

No Meeting shall be continued after ten o'clock, nor any new matter be introduced by motion, or otherwise, after nine o'clock.

X. *Of the disposition of Money, and making new Laws.*

No part of the Society's stock shall be disposed of in *Premiums*, or otherwise, nor shall any new laws be made, until the same have been proposed at one meeting, and are agreed to by two-thirds of twenty or more Members present at a subsequent meeting.

XI. *Of other Proceedings of the Society.*

No question shall be put on a *motion*, unless the motion be *seconded*; and the determination of any question shall be by *ballot*, instead of open suffrage, if desired by any four Members. In case of an equality of votes on any question, the same shall be deferred to another meeting.

WHEN any Member speaks he shall stand up, and address himself to the Chair, and the rest shall remain silent in their seats. When two or more offer to speak at the same time, the pre-

siding Member, in that, as in other matters of order, shall regulate and determine who shall speak first.

XII. Of Committees.

THE Members of this Society shall be classed into one or more of the following COMMITTEES.

1. Geography, Mathematics, Natural Philosophy and Astronomy.
2. Medicine and Anatomy.
3. Natural History and Chemistry.
4. Trade and Commerce.
5. Mechanics and Architecture.
6. Husbandry and American Improvements.

THESE Committees shall meet on their own adjournments, and at such other times as the Society shall appoint, for the consideration of any matters referred to them, and shall have power to chuse their own Chairman. But no Committee, as such, shall take up any new business of the Society, but shall confine themselves only to the subjects for which they are appointed, and to matters referred to them by the Society.

*A true Copy, compared with
the original Laws in the
Society's Books, by - -*

WILLIAM SMITH,
CHARLES THOMSON, } Secretaries.



L I S T,

For the Y E A R 1770,

Of the OFFICERS and MEMBERS of the AMERICAN
PHILOSOPHICAL SOCIETY, held at *Philadelphia*, for
promoting useful Knowledge.--

PATRON. The GOVERNOR of the Province, for the
Time being.

OFFICERS, elected *January 5th*, 1770.

PRESIDENT. Benj. Franklin, LL.D. F.R.S. *Gott. S. Soc.*

VICE-PRESIDENTS. { Joseph Galloway, Esq; Speaker
of the Assembly of Penn-
sylvania.

Dr. Thomas Bond.

Samuel Rhoads, Esq;

TREASURER. Mr. Philip Syng.

{ William Smith, D. D. Provost of
the College of Philadelphia.

SECRETARIES. { Mr. Charles Thomson.

Thomas Mifflin.

George Roberts.

CURATORS. { Benjamin Rush, M. D. Professor of
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Mr. Owen Biddle.

Isaac Bartram.

Honorable

A

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Andrew Allen, Esq;

James Allen, Esq;

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Dr. James Anderson of Maryland.

Mr. Arbo of Bethlehem, Pennsylvania.

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B

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Moses Bartram.

William Bartram.

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Mr. John Benezet.

Dr. Charles Bensal, of Germantown, Philadelphia County.

Mr.

* All those Members, whose places of abode are not specified, are of the City of Philadelphia.

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 Edward Biddle, Esq; of Reading in Pennsylvania.
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 Phineas Bond, M. D.
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 Thomas Bradford.
 Joseph Bringham.
 George Bryan, Esq;

C

Dr. Thomas Cadwalader.
 Mr. John Cadwalader.
 Lambert Cadwalader.
 Samuel Caldwell.
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 Dr. John Chapman.
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 Thomas Coombe, Esq;

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G.

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Dr. Mim of York, Pennsylvania.

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Mr. George Morgan.

John

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Phyfic, Coll. Philad.

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John Okely,

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Mr. Joseph Paschal.

Stephen Paschal.

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James Pemberton.

Israel Pemberton.

Mr. Edward Penington.

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Mr. William Poole of Wilmington, Pennsylvania.

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Mr. Thomas Potts, of Philadelphia County.

Jonathan Potts, M. B. of Philadelphia County.

Samuel Powel, Esq;

Ebenezer Prime, M.D. of New-York.

Mr. Robert Proud.

Mr.

XX
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Samuel Purviance, Jun.
R.

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John Rhea.

Dr. Charles Ridgley of Dover, on Delaware.

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William Rumfey, Esq; of Maryland.

S.

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John Smith, Esq;

William Peartree Smith, Esq;

Dr. Isaac Smith,

} of the Province of
New-Jersey.

Right

Hon. William Smith, Esq; of New-York.
 Jonathan Smith, A. M.
 Mr. Robert Smith.
 Thomas Smith.
 Dr. Peter Sonmans.
 Alexander Stedman, Esq;
 Right Hon. William Earl of Stirling, of Basken-
 ridge, New-Jersey.
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 Capt. Joseph Styles.

T.

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 Mr. William West.
 Isaac Wharton.
 Samuel Wharton.
 Rev. Chauncey Whittlesey, of Connecticut.
 William White, A. M.
 Alexander Wilcocks, Esq;
 Hugh Williamson, M. D.

Thomas

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 James Wilson, Esq; of Carlisle, Pennsylvania.
 John Winthrop, Esq; F.R.S. Hollisian Prof. Math.
 at Cambridge, in New-England.

John Witherspoon, D.D. President of the College
 of New-Jersey.

Mr. James Worral.

James Wright, Esq; of Lancaster County, Penn-
 sylvania.

Mr. Benjamin Wynkoop.

Omitted under Letter C.

Myles Cooper, L. L.D. President of King's Coll.
 New-York.

EUROPEAN MEMBERS.

MONSIEUR Buffon of
Paris

Peter Bergius, M. D. Prof.
 Nat. Hist. *Stockholm*

John Martin Butt, M. D. of
Bath, England.

William Cullen, M. D. Prof.
 Med. University of *Edin-
 burgh.*

Sir Alexander Dick, M. D.
 Bart. of *Edinburgh.*

Mr. Jeremiah Dixon, *Lon-
 don.*

Mr. James Ferguson, F. R. S.
London.

John Fothergill, M.D. F.R.S.
London.

Signor Famitz of *Naples.*

Dr. John Gill of *Kinsale, Ire-
 land.*

Mr. William Hewson, Prælec-
 tor Anat. *London*

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London.

John David Hahn, M. D. Prof.
 Med. and Philos. Univer-
 sity of *Utrecht.*

Hon. Isaac Jamineau, Esq;
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Sir Charles à Linné, M. D.
 Knight of the Polar Star, First
 Physician to the King of *Swe-
 den,* Prof. Med & Bot. *Upsal.*

William Logan, M.D. *London.*

Mr. Charles Mason, *London.*

Christian Magee, L. L. D. of
Heidelberg.

Mr. Edward Nairne, *London.*

Richard Penn, jun. Esq; *Lon-
 don.*

Sir George Saville, Bart. *York,*
in England.

James Span, M. D. Prof.
 Mater. Med. University of
Dublin.

Mr. Benjamin West, *London.*

Charles Magnus Wrangel,
 D. D. of *Sweden.*

M E M B E R S

ELECTED, *January* 18th, 1771 ;

Since printing the foregoing List.

A M E R I C A.

M R. John Baynton. *
Mr. Henry Bembridge.
Mr. Samuel Felsted, of Jamaica.
Dr. Archibald Gloster, of Antigua.
Mr. Henry Hill.
Dr. James Lloyd, of Boston.
Mr. Frederic Marshal, of North-Carolina,
Dr. Morton, of Jamaica.
Dr. Samuel Preston Moore.
Mr. Joseph Ottolenge, of Georgia.
William Parr, Esqr.
Dr. Thomas Preston.
Mr. Samuel Rhoads, jun.
Mr. Richard Thomas, of Chester County, Penn-
sylvania.

E U R O P E.

Nevil Maskelyne, B. D. F. R. S. and Astrono-
mer Royal, Greenwich.

* Members, whose particular place of residence is not specified, are of the City of Philadelphia.

OFFICERS *for the Year 1771.*

PRESIDENT and VICE-PRESIDENTS, the same as
for the last Year.

TREASURER. Thomas Coombe, Esqr.

SECRETARIES.

William Smith, D. D. Provost
Coll. Philad.

David Rittenhouse, A. M.

Revd. John Ewing, A. M.

Robert Strettel Jones, A. M.

CURATORS.

Benjamin Rush, M. D.
Prof. Chem.

Adam Kuhn, M. D. Prof. Coll.
Bot. & Mat. Med. Philad.

William Shippen, jun.
M. D. Prof. Anat.

E R R A T A.

P. 4, line 12, for June 21, 1769, *read* June 21, 1768—P. 26, in tab. of the contacts, col. 3d, l. 4th and 5th, *del.* the words "*judged of as in plate 3, fig. 1*"—For the *errata* to be corrected in the Philadelphia Account of the Transit of ϕ , see the bottom of pag. 116—P. 90, l. 27, for statue, *read* statute—P. 95, l. 27, for internal, *read* external—P. 96, in the note at bottom, for book, *read* rout—P. following 115, for 217 fol. *read* 116—l. 13, of same page, for 1770, *read* 1771.

Append. Page 2, line 12, for 1—11",5, *read*—11",5—P. 6, l. 5, for July 1st and 2d, *read* 3d and 4th—P. 62, in col. 5, opposite Greenwich, for 11'. 2", *read* 7h. 11'. 2"—Do. opposite Kew, *read* 7h. 10'. 44"⁴—Do. in col. 6, opposite Greenwich, for 6, *read* 7—Pag. 64, in col. 9, l. 7, for 786, *read* 768—Do. l. 17, for 422,317, *read* 422,817.

C O N T E N T S.

A DESCRIPTION of an ORRERY, executed on a new plan. By D. RITTENHOUSE, A. M. Page 1

Calculation of the Transit of Venus over the Sun, as it is to happen June 3d 1769, in lat 40° . N. long. 5 b. West from Greenwich. By D. RITTENHOUSE, A. M. communicated June 21st 1768. P. 4

Calculation of the same for the city of Philadelphia. By Rev. JOHN EWING, A. M. Communicated June 21st, 1768. P. 5

An account of the Transit of VENUS over the SUN, June 3d, 1769, as observed at NORRITON, in Pennsylvania. By the Committee appointed for that observation. Drawn up, and communicated, in behalf of the Committee, by Rev. WILLIAM SMITH, D. D. P. 8

An account of the TRANSIT OF VENUS over the SUN, June 3d, 1769, and of the Transit of Mercury Nov. 9th, both as observed in the State-House Square, Philadelphia. By the Committee appointed for those observations. Drawn up and communicated, in behalf of the Committee, by Rev. JOHN EWING, A. M. P. 42

An account of the TRANSIT of VENUS over the Sun, June 3d, 1769, as observed near Cape Henlopen, on Delaware. By the Committee appointed for that observation. Drawn up and communicated, in behalf of the Committee, by Mr. OWEN BIDDLE. P. 89

At:

XXIV C O N T E N T S.

An account of the Transit of Venus over the Sun, June 3d, 1769, as observed at Providence, New England. Drawn up by BENJAMIN WEST, A. M. and transmitted to the Society by Mr Joseph Brown. P. 97

Observations of the Transit of VENUS and Eclipse of the Sun, June 3d, 1769, made at the Royal Observatory, Greenwich. By Rev. NEVIL MASKELYNE, B.D. F.R.S. and Astronomer Royal. Transmitted by himself, and communicated to the American Philosophical Society, by WILLIAM SMITH, D.D. p. 105

Some account of the Transit of Venus and Eclipse of the Sun, as observed at the LIZZARD POINT, June 3d, 1769. By Mr. JOHN BRADLEY. Extracted from a paper of the Astronomer Royal. P. 114

A letter from Rev. NEVIL MASKELYNE, B. D. F. R. S. Astronomer Royal, to Rev. WILLIAM SMITH, D. D. Provost of the College of Philadelphia, giving some account of the Hudson's Bay and other Northern observations of the Transit of Venus, June 3d, 1769. Appendix to Astron. Papers, p. 1

An account of the terrestrial measurement between the observatories of NORRITON and PHILADELPHIA; with the difference of longitude and latitude thence deduced. By WILLIAM SMITH, D. D. Append. p. 5

Apparent time of the CONTACTS of the limbs of the SUN and VENUS; with other circumstances of most note, in the different EUROPEAN observations of the Transit, June 3d, 1769. Append. p. 12

An improvement in the construction of Godfrey's (commonly called Hadley's) Quadrant. By Rev. JOHN EWING, A. M. Append. p. 21

An essay on COMETS, and an account of their luminous appearance; together with some conjectures concerning the origin of HEAT. By HUGH WILLIAMSON, M. D. Append. p. 27
A Letter

C O N T E N T S.

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The tract of country now possessed by the *English* in *North-America* is large and very extensive; the soil and climate various; and, lying between the 25th and 55th degrees of north latitude, is not only subject to the gradations from extreme heat to extreme cold, but seems capable of supplying almost all the productions of the earth. It is watered with plentiful streams, accommodated with creeks, bays and havens, and intersected by rivers, which run far into the country, and not only open an easy communication with the ocean, but, by interlocking with each other, afford an inland navigation of some thousand miles, that with no great expence might be rendered still more extensive.

By the industry of it's inhabitants, the land in many places is cleared of its wood, reduced to arable and pasture ground, and rendered fit to receive those fruits, trees, plants and grain, which are proper to every soil.---The *Indians* who were natives of this country, and whose employments were hunting and fishing, paid little regard to husbandry, or the cultivation of the land. To trade and commerce they were strangers. Elegance of living they despised. They depended

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pended on the bow, and were content if, with the fortune of the chase, the spontaneous fruits of the forest, the fish which they caught, and a little *Indian* corn which their women and children raised, they could support life. Hence it was that, upon the first discovery of *America* by the *Europeans*, *Indian* corn was the only grain found here.

The fruits, trees, plants and grain, introduced by the new inhabitants, are mostly such as were cultivated in *European* countries, from whence these inhabitants came. But the soil and climate of these countries being different from that of *Europe*, no wonder if many of them do not succeed here as well as in *Europe*.

If we may trust to the report of travellers, (a) this country, in the same degree of latitude, very nearly resembles *China*, or the tract of land that forms the eastern side of *Asia*, in soil, climate, temperature of the air, winds, weather, and many natural productions. And the same resemblance is remarkable between the western side of the old world and the western side of our con-

(a) Bell's *Travels into China*. Du Halde's *History of China*.
Kœmpfer's *History of Japan*.

iv P R E F A C E.

continent; (b) whereas the eastern and western sides of the same continent differ greatly.

From the latest and best accounts, (c) we find that *Kamtchatka*, and the coast to the north of it, are, in almost every respect, similar to *Labrador* in *America*; but very different from those parts of *Europe* which are comprehended within the same degrees of latitude.

Philadelphia lies in the 40th degree of north latitude, the very same as *Pekin* in *China*, and nearly the same with *Madrid* in *Spain*, and that part of *California*, of which *Sir Francis Drake* took possession. In *Philadelphia* and *Pekin*, which lie on the same sides of the two continents, namely, the eastern, the winters are cold, and the summers are very warm. The same winds, in both places, produce the same effects. Thus, in both, the northwest winds are cold and piercing; the southwest warm and dry; the northeast cold and wet; the southeast wet but warm. Besides, the general winds that prevail are the northwest in winter, and southwest in

(b) *Natural and Civil History of California.*

(c) *Maller's Voyages from Asia to America.*

P R E F A C E.

summer. But the case is different in *Madrid* and *California*, though these places agree with each other in almost every circumstance.

This resemblance is manifest not only in the weather and climate, but is also remarkable in the soil and natural produce. Tobacco, *Phytolacca*, (or Poke) the *Perfimmon* tree, the Mulberry tree, with several others, are natives of *China*; they are also the natives of this part of *America*. *Ginseng* is gathered to the westward of *Pekin*, and, as far as we know, has not been found in any other part of the world, except within the same degrees of latitude in *America*. These observations give grounds to hope that, if proper enquiries were made, many more of the native plants of *China*, and, very possibly, the Tea, so much in use amongst us, and now become so necessary a part of our diet, might be found in *America*.

Who knows whether the Arrack tree, of which we read, may not be the same as the *American Cocoa*; or as our Sugar Maple, which, for many years successively, will yield a large quantity of rich, sweet sap, from whence a fine spirit may be distilled? It might be worth inquiring, whether the Cotton

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ton of *Virginia*, which is different from that raised in our islands, is not the same as that of which the *Chinefe* make their fine Calicoes and Mullins; whether the *Indian* Hemp of *America*, or more probably, the Silk grass found in *Virginia*, is not the same as the *Chinefe* Herba; and whether the Silk, gathered from the trees in *China*, of which poets and travellers have told marvellous stories, is any thing more than the Cocoons, which, in many places, are to be found in great plenty, on our trees and bushes.

The Silk of *China* seems to be of different sorts; that of which their Bandanoes and coarse Silks are made, is strong and harsh; that which they work up into their fine Damasks is soft, but of a weaker thread. Hence it is probable, that they have different species of Silkworms. In this part of *America*, different kinds of Silkworms are found upon different trees and shrubs; the Cocoons of some of them, particularly those that feed on the Sassafras, are larger, and the Silk they produce, though not so fine, is much stronger than that of the *Italian* Silkworm that feeds on the Mulberry. Is there not reason then to believe that, if experiments were made with our own Silkworms, and
such

such as are most useful were propagated, this country might, in a few years, produce plenty of Silk?

Such of the plants of *China* as have been introduced here, seem to agree with our soil and climate, and to thrive in a degree equal to our warmest expectations; witness the Rice, the Whisk and the *Chinese* Vetch. These may encourage us to try others. From the trials made in our islands of the Sugar-cane, Coffee, Ginger, &c. there is reason to hope, that the spices of the *East-Indies* may be propagated and cultivated there.

Thus by introducing the produce of those countries, which lie on the east side of the old world, and particularly those of *China*, this country may be improved beyond what heretofore might have been expected. And could we be so fortunate as to introduce the industry of the *Chinese*, their arts of living and improvements in husbandry, as well as their native plants, *America* might in time become as populous as *China*, which is allowed to contain more inhabitants than any other country, of the same extent, in the world.

We

We have many trees, plants, roots and herbs, to the medical virtues and uses of which we are strangers. The fruit of our Persimmon-tree has been used, to good purpose, in brewing beer; but it was not known before the experiment made, by order of this society, last winter, that one bushel of this fruit will yield above a gallon of proof spirit, of an excellent taste and flavour. To what uses in pharmacy the gum, the bark and roots of this tree, which is so very astringent, may be applied, is unknown. The virtues of the Magnolia and Spicewood are not sufficiently ascertained, though they have been used, and found to be excellent remedies in some disorders. There is a tree called the Zanthoxilum, that grows in *Maryland, Virginia*, and both the *Carolinas*, the bark of which is of such a particular quality, that the smallest bit of it, on being chewed, stimulates the glands of the mouth and tongue, and causes a flow of saliva equal to that of a slight salivation, while its action continues. No rational experiments have yet been made to find out its virtues and uses. A number of other trees might be mentioned, such as the Sassafras, the wild Cinnamon, the Magnolia Altissima; the fragrant smell and aromatic taste of which
 prove

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prove that they have medicinal qualities, though their uses are not fully known. The Sumach likewise deserves examination. Its seed or berries, if not the wood itself, might be used in dying. The *Indians* mix its leaves with their Tobacco, and thereby render it more aromatic and agreeable in smoking. There is a species of it which yields a gum that nearly, if not exactly, resembles the Gum Copal. Indeed, there is reason to believe it is the very same,

Our Wines and Raisins are imported from foreign countries; while nature points out, that there cannot be a country more proper than this is for producing the grape. Before our lands were cleared, and so many of the Grape-Vines extirpated, foreigners, who visited this country, could not help observing and admiring the quantity that, like native vineyards, presented themselves to their view. And even now our hills, vales and level land abound with them. They grow in every soil, are suited to every climate, and without cultivation, pour forth their fruits in abundance; many of them rich and luscious to the taste. It is not a little surprising, therefore, that the culture of the Grape was not among the first of our improvements. Considering the great variety

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of Vines we have on this continent, it is not to be doubted that, with a little care and industry, *America* might produce Wine sufficient, not only for home consumption, but even for exportation; and, considering the richness of many of our Grapes, in their present wild, uncultivated state, and the improvement they must receive from culture, there is reason to hope that, in time, our Wine may be much esteemed.

It would be endless to recount all our plants, roots and herbs; many of which, though now neglected, might, with a little care and attention, become articles of commerce, and be of great use to our country. It is found from experience that Flaxseed, by reason of the drought and scorching sun in *May* and *June*, does not grow well, and Hemp requires so rich a soil, that few pieces of ground will produce it. There is a plant, a native of this country, which grows in many places, but delights more particularly in light sandy soils, known commonly by the name of *Indian Hemp*. Its bark is so strong, that the *Indians* make use of it for bow-strings. Could we but find a method of separating and softening its fibres, so as to render it fit to be spun into fine thread, it might serve as a substitute for Flax and Hemp.

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Hemp. This plant deserves to be cultivated on another account. The pod it bears contains a substance that, from its softness and elasticity, might be used instead of the finest Down. Its culture is easy, inasmuch as its root, which penetrates deep into the earth, survives the winter, and shoots out fresh stalks every spring. Five or six years after being sown, it is in its greatest perfection. With the roots of plants, unknown to white people, the *Indians* stain wood, hair and skins of a beautiful colour, that preserves its lustre for years, though exposed to the weather. With the juice of herbs they relieve many diseases, heal wounds, and cure the bite of the most venomous snakes. A perfect knowledge of these simples, and of many others, with which our country abounds, might be of great use to mankind.

The bowels of our earth are but little explored, notwithstanding the encouragement received from the experiments that have already been made. There is a great variety of Clays, many of them valuable. Of some, good crucibles have been made, and fire bricks, equal to any in the world. Others have answered so well in burning, as to induce one to hope that, in time, a porcelain, equal to that brought from *China*, may

be made here. Near *Newcastle* on *Delaware*, a clay is found, which, used as a paint, retains its colour for years, even when exposed to the weather, without any mixture of oil. In many places is found a kind of earth, which has been used instead of *Spanish* brown, and answered the end. In other places there is an ochre, which dyes a waincot colour. May not some of these clays have medicinal qualities? About eighteen miles from this city, on the banks of *Neshameny*, is a large bed of black lead. The lands to the southward are so replete with nitre, or so favourable for producing it, that, in sundry places, it appears like a hoar-frost, on the surface of the ground. We are informed that a gentleman in *Virginia* made a large quantity of saltpetre from the sweepings of his tobacco-house, for which he received a medal from the Society of Arts: And, to evince the importance of this discovery, the same gentleman asserts, that, from the floor of a tobacco-house, sixty by forty feet, may be collected, by a very simple process, sixteen hundred weight of Nitre in a year. Nay, it is said there are, if the expression may be allowed, mines of Saltpetre in the mountains.

Ofi

Of ores and minerals *America* produces variety, as well as plenty; iron, copper and lead are found in many places. Some samples of tin, antimony and bismuth ores have been lately discovered, and other minerals, the nature and properties of which are not sufficiently ascertained.

It would be worthy of every person, therefore, who wishes to improve his country, and advance its interest, to try whether he cannot find at home, or introduce from abroad, new species of plants, trees, fruits, grain, &c. suitable to our own soil and climate, for the support and ornament of life, and for articles of trade and commerce. Each one according to his opportunities and ability, should explore the virtues of our native plants, &c. and search out the treasures which nature has concealed in the bowels of the earth.

Such discoveries will not only be a benefit to ourselves, but they will render us more useful to our Mother Country. They will give full scope to our industry, without exciting her jealousy, or interfering in the least with her manufactories; they will enlarge and give stability to her commerce. For, if by these means, the continental colonies

lonies can supply her with the rarities of *China*, and her islands can furnish the rich spices of the *East-Indies*; her merchants will no longer be obliged, in order to obtain these, to traverse three quarters of the globe, encounter the difficulties of so tedious a voyage, and, after all, submit to the insolence, or exorbitant demands of foreigners.

Already has *Britain* experienced the advantage of her colonies furnishing those articles, with which she used to be supplied by foreign nations. In the infancy of the colonies, and before they were settled, she depended on *Sweden* and *Russia* for naval stores. These nations, imagining that she could not procure them elsewhere, and resolving to increase their gain, entered into a combination to raise the price : And had not her colonies furnished these articles, she must have given up the empire of the sea, or submitted to their arbitrary impositions.

But to accomplish these desirable ends, it is esteemed necessary, and proposed, that Men of Learning and Enquiry should turn their thoughts and attention to these subjects. The bulk of mankind follow a beaten track. They seldom turn their thoughts to experiments, and scarcely ever adopt a new measure

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measure, until they are well assured of success and advantage from it, or are set upon it by those, who have weight and influence with them.

That this Society may, as far as in their power; contribute to the carrying such a Plan into execution, it is proposed to make it a principal part of their business to inquire, and try to find out, what our country is capable of producing; what improvements may be made in agriculture, farming, gardening, &c. The best methods of manuring land, of restoring soils, that are worn out, and of protecting and guarding our fruits, trees, plants, and grains, from worms, insects, and blasts; how to improve the breed of useful animals, and introduce other species from foreign countries; how to preserve our timber for ship-building and other purposes, and to increase the most valuable sorts, the best time for felling and the best method of seasoning it; what are the virtues and uses of the many plants, &c. which this country produces; what exotics or medicinal plants may be introduced, and the best method of propagating the most useful of them; what new vegetable juices may be discovered, and the best way of managing them; what improvements may be

be made in the art of fermentation, making of wine, cyder, vinegar, &c. the cheapest and best methods of making highways, causeways, and bridges, joining of rivers, and increasing our inland navigation.

But it is not proposed to confine the views of the Society, wholly, to these things, so as to exclude other useful subjects, either in physics, mechanics, astronomy, mathematics, &c.

The means of conveying knowledge are now become easy. Printing Houses are erected in all the principal towns on the continent, and regular posts established to carry letters and papers from one to another. *Philadelphia*, (the place where this Society meets) hath, by its central situation, not only a ready communication by land, with our Continental-Colonies; but likewise with our Islands, by vessels employed in carrying on our trade. Besides, hints thrown out in our public circulating papers are not lost, as in this country, almost every man is fond of reading, and seems to have a thirst for knowledge.

The Society are very sensible how unequal they are to the task of carrying into execution a plan of so extensive a nature.

But

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But they hope the usefulness of it will procure them the countenance and assistance of every man who wishes well to his country.

There are many gentlemen in different parts of the country, whom Providence hath blessed with Affluence, and whose understanding is improved by a liberal education. From such the Society promise themselves great assistance, as their fortunes enable them to make experiments, which men of narrow circumstances would not dare to attempt. The farmers employed in cultivating the lands are intelligent and sensible, capable of observation, and of making many useful experiments. From these we shall thankfully receive every hint and practical observation, relative to the improvement of their farms, the culture of trees and grain, the raising of stock, &c. As among our mechanics many are expert and ingenious, the Society hope to be favoured with any new inventions and discoveries they shall make; and as many of our young men, who have turned their thoughts to philosophical subjects, have discovered such a degree of judgment and genius, as will enable them to carry their researches far into nature, their sentiments on such subjects, as

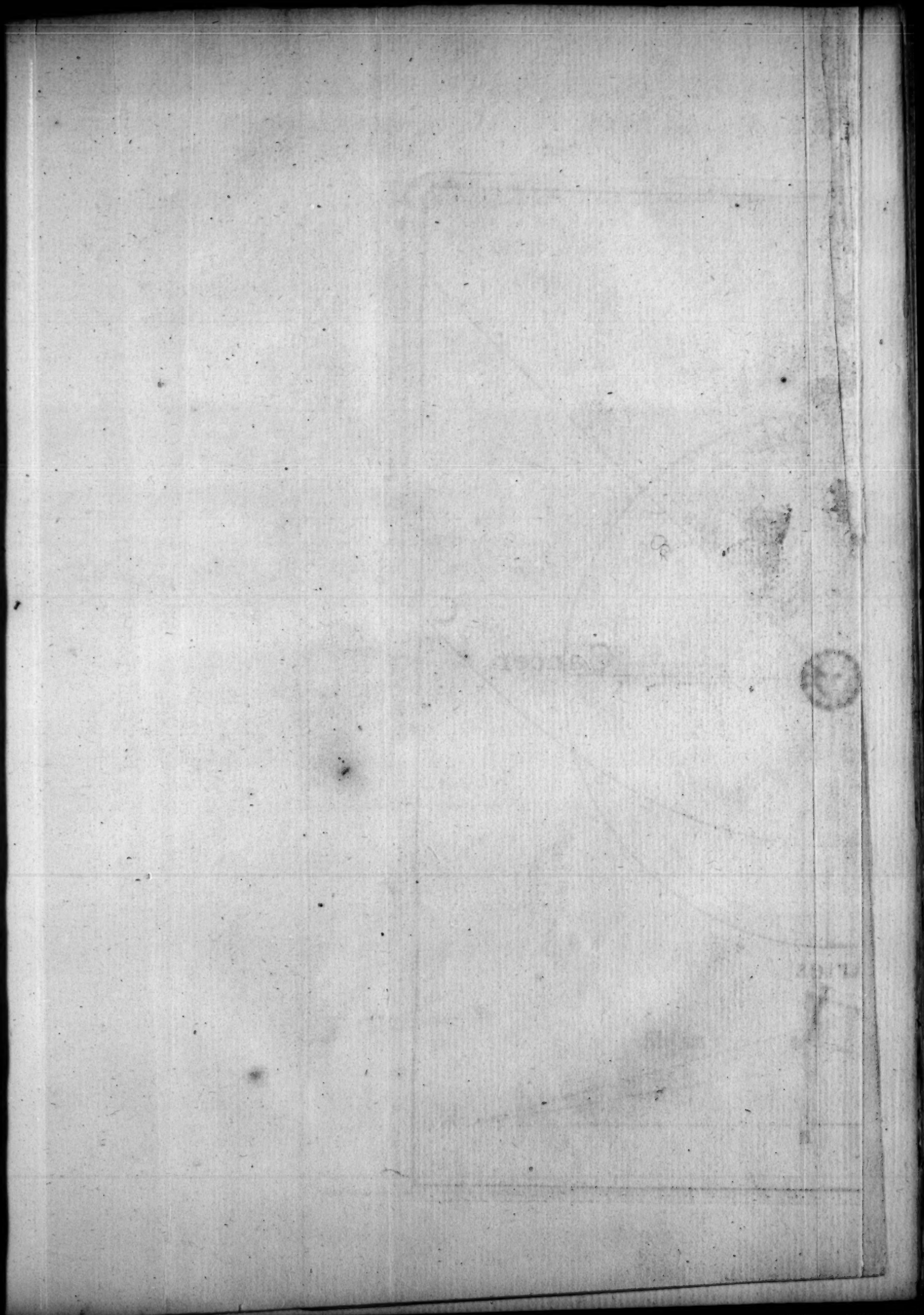
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they shall be pleased to communicate to us, shall be received with thankfulness. For, besides the other advantages that may redound from an institution of this sort, it may have a tendency to inspire our youth with a love of knowledge, to draw them gently from scenes of dissipation, and to animate them with a laudable desire of distinguishing themselves by improvements in arts and sciences, and by useful discoveries that may do honour to themselves, and promote the interest of their country.

Every specimen of what is curious or valuable in forming a cabinet, or collection of fossil, vegetable or animal substances, that may enlarge the bounds of natural history in general, and of this part of the world in particular, will be esteemed agreeable presents, and grateful acknowledgments will be made to the respective donors.

The Society propose, as soon as their Stock will enable them, to reward with suitable premiums every person who shall make any valuable improvement, invention or discovery, in any of the subjects before mentioned. They will always be ready to incorporate, as members, those who deserve
well



PLATE, I

Fig II

Parabolic Trajectory of the Comet 1770

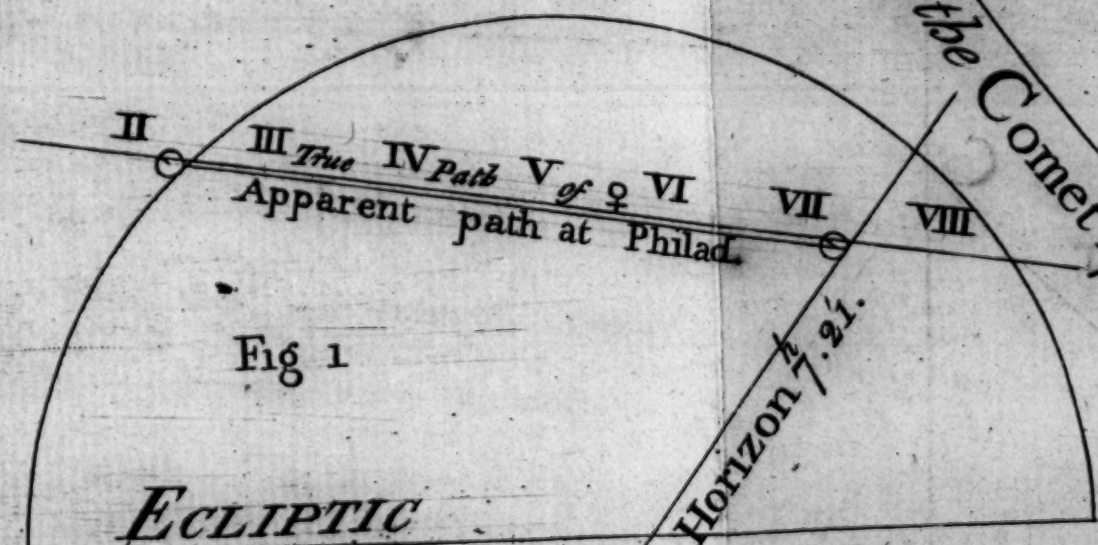


Fig 1

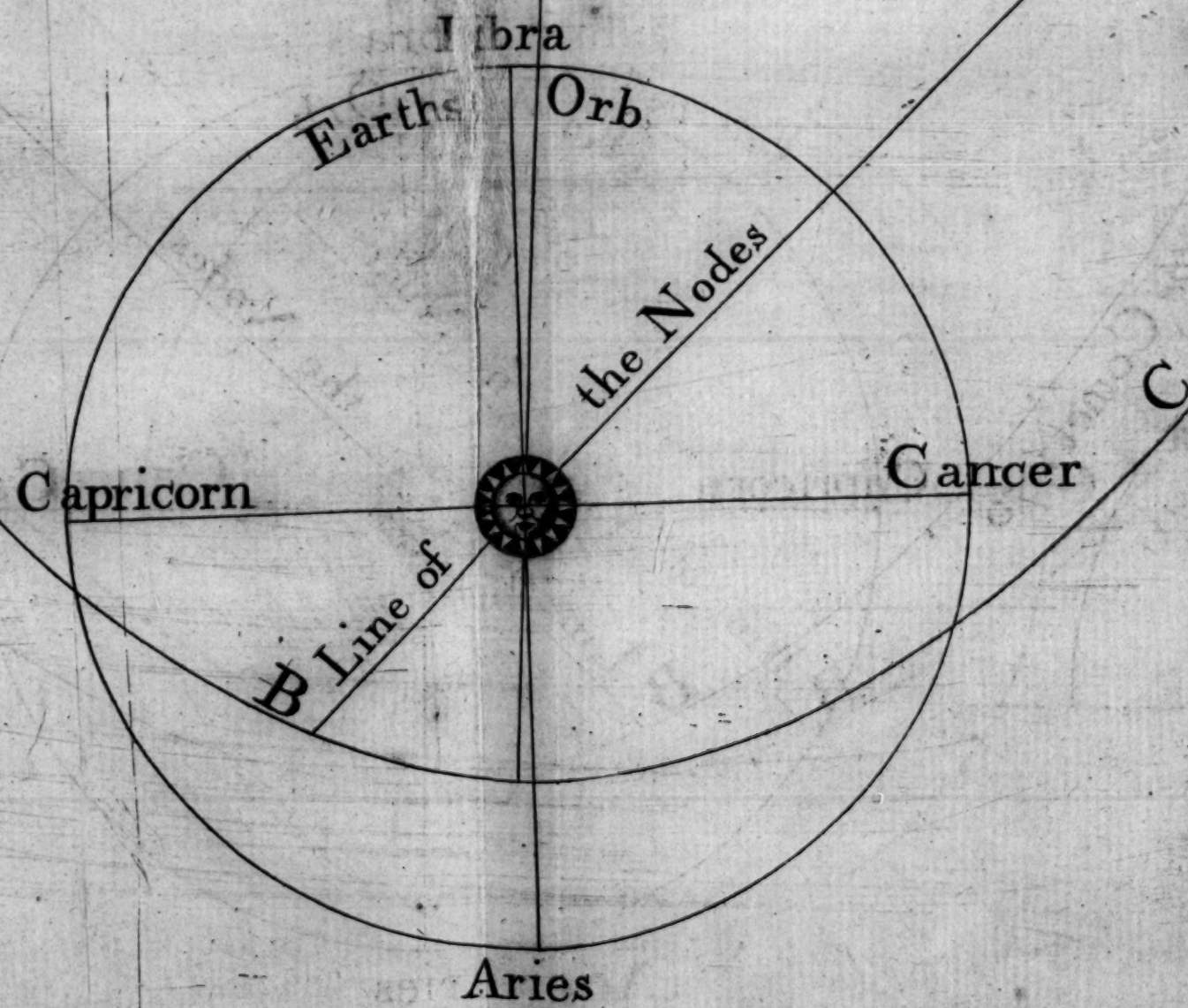


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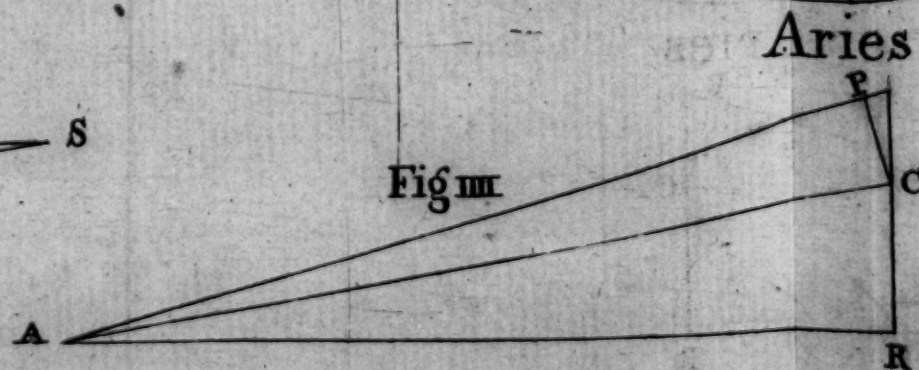
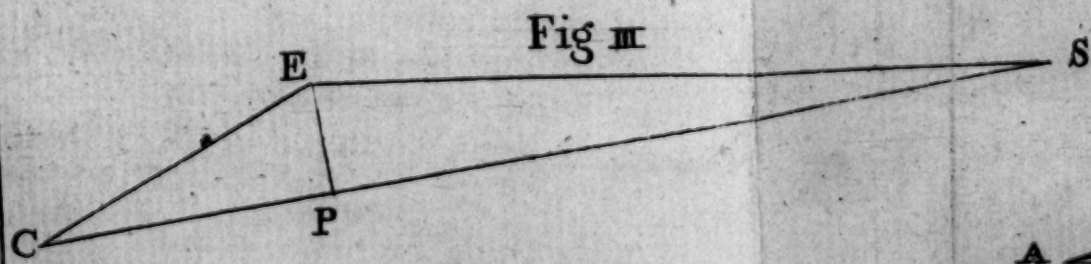


PLATE I

Fig. 1

Fig. 2

Fig. 3

Fig. 4

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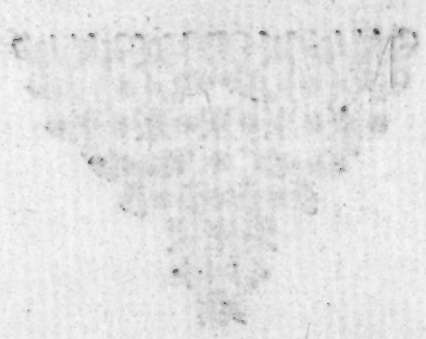
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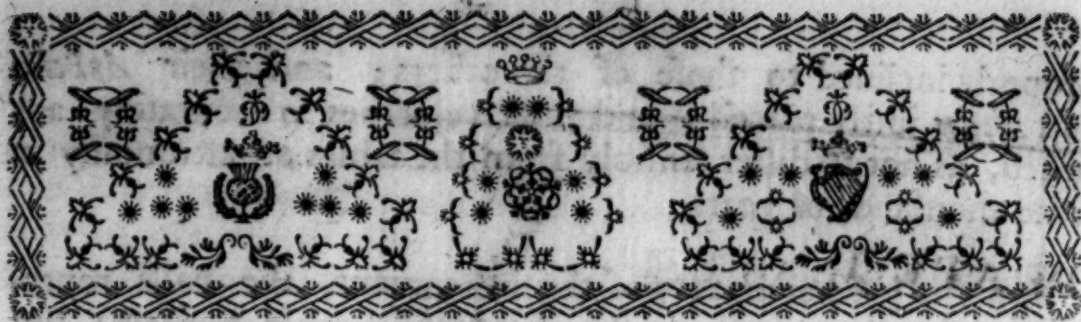
well of their country. In short, the chief merit the Society mean to claim to themselves is only that of encouraging and directing inquiries and experiments, of receiving, collecting and digesting discoveries, inventions and improvements, of communicating them to the public, and distinguishing the authors; and of thus uniting the labours of many, to attain one end, namely, the advancement of useful knowledge and improvement of our country.



P R E F A C E

well of their country. It is the chief
merit the Society seems to claim to them-
selves is only that of encouraging and di-
recting inquiries and experiments of every
kind, collecting and digesting the various in-
quiries and improvements of agriculture,
carrying them to the public, and disseminating
the authors; and of thus uniting the labours
of many, to attain one end, namely, the
advancement of useful knowledge and im-
provement of our country.





TRANSACTIONS

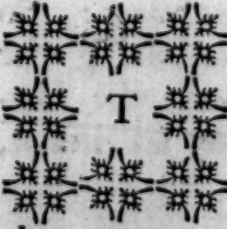
OF THE

American PHILOSOPHICAL SOCIETY, &c.

SECT. I.

MATHEMATICAL *and* ASTRONOMICAL PAPERS.

A description of a new ORRERY, planned, and now nearly finished, by David Rittenhouse, A. M. of Norriton, in the county of Philadelphia. Communicated by Dr. SMITH.

 HIS machine is intended to have three faces, standing perpendicular to the horizon : That in the front to be four feet square, made of sheet brass, curiously polished, silvered and painted in proper places, and otherwise ornamented. From the center arises an axis, to support a gilded brass ball, intended to represent the *sun*. Round this ball move others, made of brass or ivory, to represent the *planets* : They are to move in elliptical orbits, having the central ball in one focus ; and their motions to be sometimes swifter, and sometimes slower, as nearly according to the true law of an equable description of areas as is possible, without too great a complication of wheel-work. The orbit of each planet is likewise to be
A properly

properly inclined to those of the others; and their *Aphelia* and *Nodes* justly placed; and their velocities so accurately adjusted, as not to differ sensibly from the tables of astronomy in some thousands of years.

For the greater beauty of the instrument, the balls representing the planets, are to be of a considerable bigness; but so contrived, that they may be taken off at pleasure, and others, much smaller, and fitter for some purposes, put in their places.

When the machine is put in motion, by the turning of a winch, there are three indexes, which point out the hour of the day, the day of the month, and the year, (according to the *Julian* account) answering to that situation of the heavenly bodies which it then represented; and so continually, for a period of 5000 years, either forward or backward.

In order to know the true situation of a planet, at any particular time, the small set of balls are to be put each on its respective axis, then the winch to be turned round 'till each index points to the given time; then a small *Telescope*, made for the purpose, is to be applied to the central ball, and directing it to the planet, its longitude and inclination will be seen on a large brass circle, silvered, and properly graduated, representing the *Zodiac*, and having a motion of one degree in 72 years, agreeable to the precession of the *Equinoxes*: So likewise by applying the telescope to the ball representing the *Earth*, and directing it to any planet, then will both the longitude and latitude of that planet be pointed out (by an index, and graduated circle) as seen from the earth.

The two lesser *Faces* are four feet in height, and 2 feet 3 inches in breadth: One of them represents and exhibits all the appearances of *Jupiter*, and his satellites, their eclipses, transits and inclinations: Likewise all the appearances of *Saturn*, with his ring and satellites. And the other represents all the phenomena of the *Moon*, particularly the exact time, quantity, and duration of her eclipses, and those of the *Sun*.

Sun, occasioned by her interposition; with a most curious contrivance for exhibiting the appearance of a *Solar Eclipse* at any particular place on the earth: Likewise the true place of the *Moon* in the signs, with her latitude, and the place of her *Apogee* and *Nodes*, the *Sun's* declination, equation of time, &c. It must be understood that all these motions are to correspond exactly with the celestial motions, and not to differ some *Degrees* from the truth, as is common in orreries.

THE whole may be adjusted to, and kept in motion by, a strong *Pendulum Clock*, nevertheless, at liberty to be turned by the winch, and adjusted to any time, past or future.

N. B. THE above machine is to be supported by a mahogany case, adorned with foliage, and some of the best enrichments of sculpture. The part containing the mechanical astronomy of the *Moon*, has been sometime finished, and is found perfectly to answer, by many trials already made of it. The remainder of the work, is now almost compleated. The clock part of it may be contrived to play a great variety of *Music*.

The following CALCULATIONS and PROJECTIONS of the Transit of Venus were laid before the Society agreeable to their Dates, and claim a Place here, as it may be of use, in various Respects, to compare them with the actual Observations of the Transit, afterwards made in this Province; and from thence to collect the Differences between Computation and Observation, together with the Causes of those Differences.

PROJECTION of the ensuing TRANSIT of VENUS over the SUN, which is to happen June 3d, 1769. By David Rittenhouse, A. M.

ELEMENTS from Halley's Tables, for Lat. 40° N. & Long. 75° W. from Greenwich.

Communicated by Revd. Dr. Smith, June 21, 1769.

1769, June 3d, at 3 h. P. M Sun's place, $2^{\circ} 13' 21'' 37''$
Heliocentric place of ♀ in ecliptic, $8. 13. 18. 11$ Lat. ♀ N. $4^{\circ} 29''$

$\ominus \text{ à } ♀ \quad 3' 26''$

At 8 Hours P. M. Sun's Place, $2^{\circ} 13' 33' 35''$
Place of Venus $8. 13. 38. 2$ Lat. ♀ N. $3^{\circ} 18''$

$♀ \text{ à } \ominus \quad 4. 27$

Log. $\ominus \text{ à } \odot$	5.006568	Distance	10152385
Log. ♀ à $\odot$	4.861095	Dist.	7262652
Log. ♀ à $\ominus$	4.460858	Dist.	2889733
Diff. Log.	.400237		

Apparent Semidiameter of $\odot$	$15'. 51'' = 15'. 85$	
Apparent Semidiameter of ♀	- - -	$0', 5719$
Diminish'd * Semidiam. of $\odot$	$6', 3065$	} in Ratio of 7262 to 2889
Diminish'd Semidiam. of ♀	$0, 2276$	

Beginning of the Transit, 2h. 16"
End 8. 50

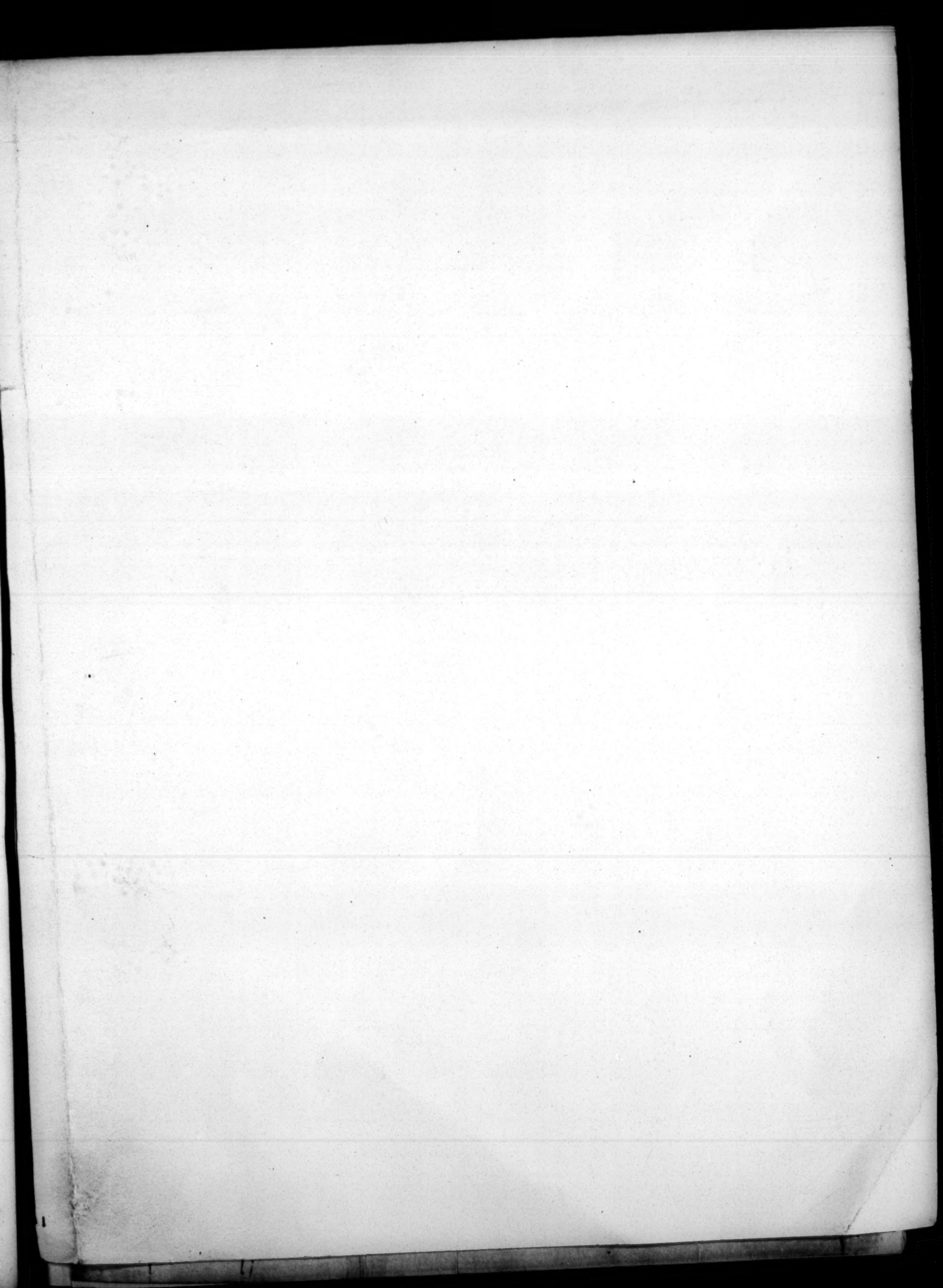
But supposing the Sun's Horizontal Parallax but 8 Seconds, then for the above Lat. and Lon.

First External Contact will be at 2h. 11min.

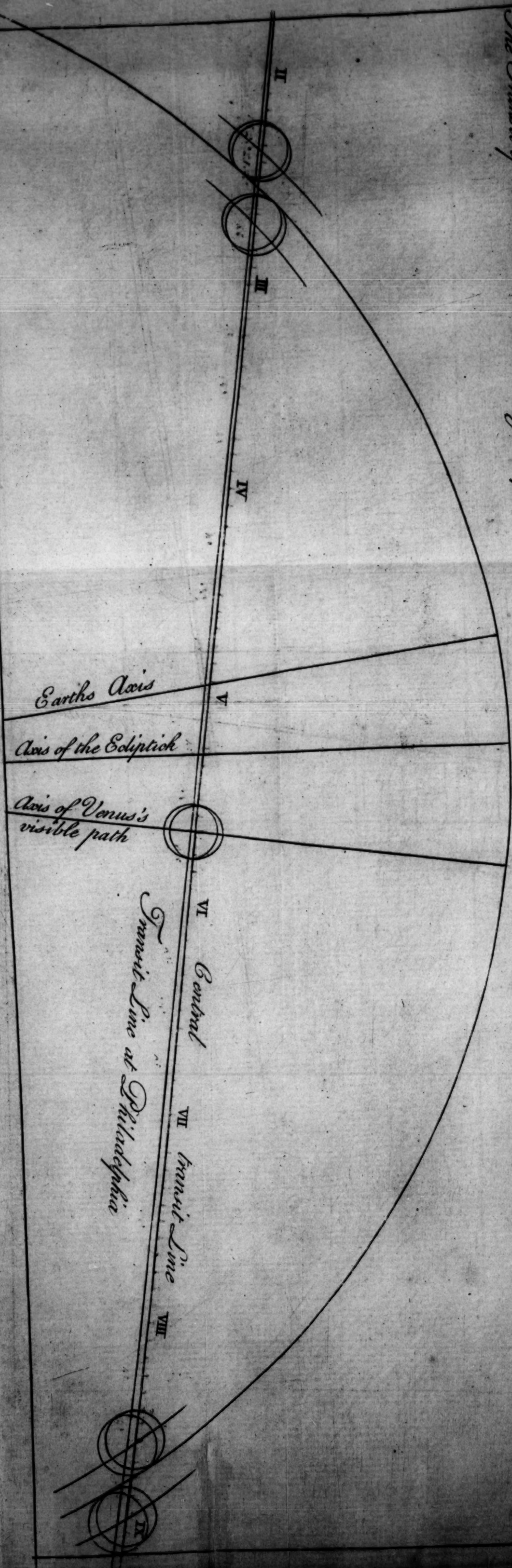
* The Diameters were diminished to answer the Scale to which the Latitude of Venus was set off in the Projection.

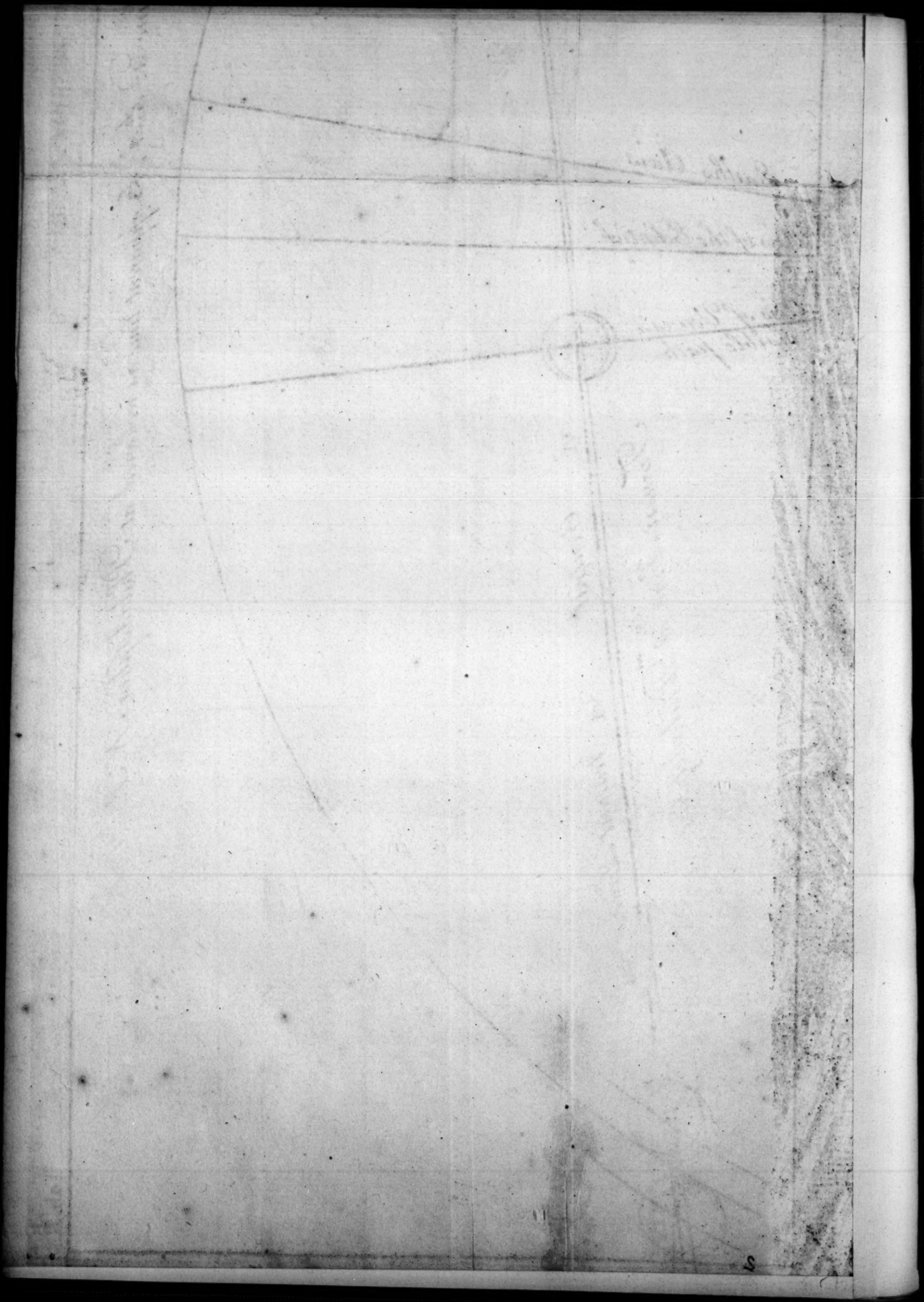
See the Projection; Plate, I.

The



The Transit of Venus over the Sun in the Year 1769 June 3^d 5^h 41^m 43^s apparent time as reckoned at Philadelphia N. E. S. P. M.





The following Paper by the Revd. Mr. EWING, was also communicated, June 21, 1768.

GENTLEMEN,

AS you have taken under consideration, the proposal which I made to you the 19th of April last, of observing the ensuing Transit of Venus over the Disk of the Sun, which will be on the 3d of June, 1769; permit me to lay before you a projection of the Transit, as seen from Philadelphia, together with the elements of the projection, deduced from as accurate a calculation as I could make from Dr. Halley's tables. I find from the observations made on the last Transit in June, 1761, that the mean motion of Venus, for the year 1769, should be $21''$ more than these tables make it, and that the place of the nodes of Venus, as stated in these tables, needs the following correction. At the time of the ecliptical conjunction of the Sun and Venus in June 1761, their place was $2^{\circ} 15' 36'' 33''$, and her geocentric latitude was $9' 44'' .9$ south. Then say, as $72626 .3$ the distance of Venus from the Sun : $28894 .9$ the dist. of Venus from the earth : : $584'' .9$ her geocentric latitude : $3' 52'' .71$ her heliocentric latitude at that time. Then say, as the tangent of the inclination of her orbit with the ecliptic, is to rad. so is the tangent of her heliocentric latitude to the sine of her dist. from the node; *i. e.* as, $T, 3^{\circ} 23' 20'' : \text{rad.} :: T, 3' 52'' .71 : S, 1^{\circ} 5' 14''$, which deduct from her place June 6th, 1761, at the time of the transit, viz. at $5\text{h. } 57' 20''$ at Greenwich; and the remainder viz. $2^{\circ} 14' 31' 19''$ is the place of her ascending node at that time. The motion of her nodes, as stated by Dr. Halley, is $31''$ per annum; therefore, for 8 years, add $4' 8''$ to the abovementioned place of her node, and the sum, viz. $2^{\circ} 14' 35' 27''$ is the place of the node in the year 1769, June 3d. With these corrected elements, and others, as in the tables, the following calculations are made.

THE apparent time of the ecliptical conjunction of the Sun and Venus, as seen from the center of the earth, 1769,

B

June

June 3d, 5^h. 4' 43", as reckoned at Philadelphia, 5^h. 0' 32" west from Greenwich. The place of the Sun and Venus, at the time of the transit, is 2^h 13° 26' 32". The place of her descending node is 8° 14' 35" 27" at that time. The geocentric latitude of Venus at that time is 10' 16". 295. The Sun's semidiameter is 15' 45". 65. The semidiameter of Venus 0' 29". Their sum 16' 14". 65; their difference is 15' 16". 65. Venus's horary motion from the Sun 3' 57". 43. The angle made by the axis of the earth and ecliptic, as seen from the Sun, 7° 3' 16". The angle made by the axis of Venus's visible path and the axis of the ecliptic, is 8° 34' 17"; the angular point or node being 1° 8' 55" west of the Sun. The angle made by the earth's axis and the axis of Venus's visible path is equal to the sum of these 15° 37' 35". The horizontal parallax of the sun on the day of the transit is 8". 5204, when his distance from the earth is 101521.2, his parallax at his mean distance 100000 being supposed to be 8". 65, as found at the last transit 1761. The horizontal parallax of Venus on the day of the transit 29". 9348, when her distance from the Sun is 72626.3, her mean distance being according to her periodic time 72333. The difference of these, viz. 21". 4144, is the horizontal parallax of Venus from the Sun on the said day. The Transit begins, as seen from the earth's center, at 2^h. 17' 20". 48, and ends at 8^h. 41' 46". 72. The total ingress at 2^h. 36' 31". 38; the beginning of egress at 8^h. 22' 35". 82; so that the whole duration between the internal contacts will be 5^h. 46' 4". 44. But these times will be considerably altered by the parallaxes of Venus in longitude and latitude, as observed from different parts of the earth. The whole effect of the parallaxes of longitude and latitude at the time of the external contact to hasten it, being 3' 31", the time of it, as seen from Philadelphia, is at 2^h. 13' 49" 28" P. M. And the time of total ingress at Philadelphia is 2^h. 32' 27"; the total effect of these parallaxes to accelerate the internal contact being 4' 4".

THESE times depend upon the longitude of Philadelphia West of Greenwich, which in this calculation is supposed to be 5^h. 0' 32", which is as near as I have yet been able to ascertain it, by comparing a number of observations made on the eclipses of

of the first satellite of Jupiter, with Mr. Emmerson's tables. But these cannot be depended upon for the longitude, within a minute or two of time, which will by no means answer the design of ascertaining the distances of the Sun and planets by the ensuing transit. I would therefore beg leave to propose to the Society, that provision be made, without loss of time, for erecting a small observatory in some convenient place, that the occultations of some known stars by the Moon, and the eclipses of Jupiter's satellites, may be noted, and compared with the corresponding observations made at Greenwich, and other places: And that some proper persons be appointed to make the observations, at the expence of the Society, that our longitude may be ascertained with the precision that is necessary. It would be proper, that at least two sets of observers be appointed to view the transit in this city, in order to guard against the fatal accident of losing the Sun out of the field of the telescope, in the critical and important moment; which I find happened to a good astronomer in the East-Indies, at the time of the last transit. It is very difficult to preserve a celestial object in the field of a telescope, that magnifies considerably.

THE expence of making these observations, with sufficient accuracy, must be considerable; but it is hoped that an opportunity will not be neglected on this account, which, for its importance to the interests of astronomy and navigation, has justly drawn the attention of every civilized nation in the world, and which will not be presented again for more than a century to come.

THESE things are submitted, with all humility and deference, to the judgment of this respectable Society, by

Their very humble Servant,

Philadelphia, June 14, 1768.

JOHN EWING.

N. B. The difference between some of these Numbers and those printed in the American Magazine, was occasioned by neglecting the 21st of correction in the place of Venus, as inconsiderable; the effect of which is here taken into the computation, and the result is set down above. See the projection, plate 2.

An Account of the TRANSIT OF VENUS over the SUN'S DISC, as observed at NORRITON, in the County of Philadelphia, and Province of Pennsylvania, June 3d, 1769.

By WILLIAM SMITH, D. D. Provost of the College of Philadelphia, JOHN LUKENS, Esq; Surveyor-General of Pennsylvania, DAVID RITTENHOUSE, A. M. of Norriton, and JOHN SELLERS, Esq; Representative in Assembly, for Chester County-----

Being the Committee appointed for that Observation, by the AMERICAN PHILOSOPHICAL SOCIETY, held at Philadelphia, for promoting useful Knowledge.

Communicated to the SOCIETY, July 20th, 1769, by Direction, and in Behalf of, the Committee; by Dr. SMITH.

GENTLEMEN,

AMONG the various public spirited designs, that have engaged the attention of this Society, since its first Institution; none does them more honor than their early resolution to appoint COMMITTEES, of their own Members, to take as many observations, in different places, of that *rare Phenomenon*, the TRANSIT OF VENUS over the SUN'S DISC, as they had any probability of being able to defray the expence of, either from their own funds, or the public assistance they expected.

As the members of the Norriton-Committee live at some distance from each other, I am, therefore, at their request, now to digest and lay before you, in one view, the whole of our observations in that place; distinguishing, however, the part of each observer; and going back to the first preparations. For I am persuaded that the dependence, which the learned world may place on any particular Transit-Account, will

will be in proportion to the previous and subsequent care, which is found to have been taken in a series of accurate and well conducted observations, for ascertaining the *going* of the time-pieces, and fixing the Latitude and Longitude of the places of observation, &c.

AND I am the more desirous to be particular in these points, in order to do justice to Mr. *Rittenhouse*, one of our Committee; to whose extraordinary skill and diligence is owing whatever advantage may be derived, in these respects, to our observation of the *Transit* itself. It is further presumed, that Astronomers, in distant countries, will be desirous to have not only the work and results belonging to each particular *Transit-Observation*, but the materials also, that they may examine and conclude for themselves. And this may be more particularly requisite, in a New Observatory, such as *Norriton*, the name of which hath perhaps never before been heard of by distant Astronomers; and therefore, its latitude and longitude are to be once fixed, from principles that may be satisfactory on the present, as well as on any future, occasion.

OUR great discouragement, at our first appointment, was the want of proper apparatus, especially good *Telescopes*, with *Micrometers*. The generosity of our *Provincial Assembly* soon removed a great part of this discouragement, not only by their vote to purchase one of the best Reflecting Telescopes, with a *Dollond's* Micrometer; but likewise by their subsequent donation of *One Hundred Pounds*, for erecting Observatories, and defraying other incidental expences. It was foreseen that on the arrival of this Telescope, added to such private ones as might be procured in the city, together with fitting up the instruments belonging to the Honorable the Proprietaries of the Province, viz. the *equal Altitude* and *Transit Instrument*, and the large astronomical *Sector*, nothing would be wanting for the *City-Observatory* in the State-House Square, but a good Time-Piece, which was easily to be procured.

WE remained however still at a loss, how to furnish the *Norriton Observatory*. But even this difficulty gradually vanished.
Early

Early in *September*, 1768, soon after the nomination of our *Committees*, I received a letter from that worthy and honorable Gentleman, THOMAS PENN, Esq; one of the Proprietaries of this Province, which he wrote at the desire of the Rev. Mr. *Maskelyne*, Astronomer Royal, expressing their desire, "That we would exert ourselves in observing the Transit, for which our situation would be so favourable"; and enclosing some copies of Mr. *Maskelyne's* printed directions for that purpose.

THIS gave me an opportunity, which I immediately embraced, of acquainting Mr. PENN what preparations we had already made; and what encouragement the Assembly had given in voting *One Hundred Pounds Sterling*, for the purchase of One Reflecting Telescope and Micrometer, for the City Observatory; but that we should be at a great loss for a telescope of the like construction for the *Norriton Observatory*, and requesting him to order a *Reflector* of two, or two and an half feet, with *Dollond's* Micrometer, to be got ready as soon as possible in *London*. It was not long before I had the pleasure to hear that Mr. PENN had ordered such a Telescope, which came to hand about the middle of *May*, with a most obliging letter, expressing the satisfaction he had in hearing of the spirit shewn at *Philadelphia*, for observing this curious Phænomenon when it should happen; and concluding as follows---

"I HAVE sent, by Capt. *Sparks*, a Reflecting-Telescope with *Dollond's* Micrometer, exact to your request, which I hope will come safe to hand. After making your observation with it, I desire you will present it, in my name, to the College---Messrs. *Mason* and *Dixon* tell me, they never used a better than that* which I formerly sent to the Library Com-

* Mr. OWEN BIDDLE, who was appointed by the Society to conduct the observation near *Cape Henlopen*, had this telescope; nothing being desired there but the *contacts* and their exact time; which he obtained to great satisfaction, as by his report may appear. As he had but short time to prepare, and there was a difficulty in getting the necessary apparatus for fixing, by his own observations, the longitude and latitude of the place chosen for his station, it was resolved to depend on the ascertaining these articles, by running a line from the place of his observation to a known point in the work of Messrs. *Mason* and *Dixon*, when employed in settling the boundary lines of *Pennsylvania* and *Maryland*; and in measuring a degree of latitude, along that fine level peninsula, between *Delaware* and *Cheasapeake Bays*.

"pany



"pany of *Philadelphia*, with which a good observation may be made, tho' it has no micrometer."

WE were now enabled to furnish the *Norriton Observatory*, as follows, viz.

1. A GREGORIAN REFLECTOR about 2 f. focal length, with a *Dollond's* Micrometer. This Telescope hath four different magnifying powers, viz. 55; 95, 130, and 200 times; by means of two Tubes containing eye-glasses that magnify differently, and two small Speculums of different focal distances.

Made by *Nairne*. Used by Dr. SMITH.

2. A REFRACTOR of 42 f. its magnifying power about 140. The glasses were sent from *London* with the large Reflector, and belonged to *Harvard College, New-England*; but as they did not arrive time enough to be sent to that place before the Transit, they were fitted up here, by Mr. *Rittenhouse*; and----

Used by Mr. LUKENS.

3. MR. *Rittenhouse's* REFRACTOR, with an object glass of 36 f. focus, and a convex eye-glass of 3 inches, magnifying about 144 times.

Used by HIMSELF.

BOTH these Refractors, as well as the Reflector, were in most exquisite order.

4. AN *Equal-Altitude Instrument*; its telescope three and an half f. focal length, with two horizontal hairs, and a vertical one, in its focus, firmly supported on a stone pedestal, and easily adjusted to a plummet wire 4 feet in length, by 2 screws; one moving it in a North and South, the other in an East and West, direction.

5. A TRANSIT-TELESCOPE, fixed in the *Meridian* on an axis with fine steel points; so that the hair in its focus can move in no other direction than along the meridian; in which are two marks South and North, about 330 yards distance each; to which it can be readily adjusted in a horizontal position by one screw, as it can in a vertical position by another screw.

6. AN

6. AN excellent TIME-PIECE, having for its pendulum-rod a flat steel-bar, with a *bob* weighing about 12 lb. and vibrating in a small arch. It goes 8 days, does not stop when wound up, beats dead seconds, and is kept in motion by a weight of 5 pounds.

THESE three last articles were also Mr. *Rittenhouse's* property, and made by himself.

7. AN ASTRONOMICAL QUADRANT, two and an half f. radius, made by *Sisson*, the property of the *East-Jersey* Proprietors; under the care of the Right Hon. *William* Earl of *Stirling*, Surveyor-General of that Province; from whom Mr. *Lukens* procured the use of it, and sent it up to Mr. *Rittenhouse* for ascertaining the latitude of the Observatory. Thus we were at length compleatly furnished with every instrument proper for our work.

As Mr. *Rittenhouse's* dwelling at *Norriton* is about 20 miles North-West of *Philadelphia*, our other engagements did not permit Mr. *Lukens* or myself, to pay much attention to the necessary preparations; but we knew that we had entrusted them to a gentleman on the spot, who had joined to a compleat skill in *Mechanics*, so extensive an *astronomical* and *mathematical* knowlege, that the use, management, and even the construction, of the necessary apparatus, were perfectly familiar to him. Mr. *Lukens* and myself could not set out for his house till *Thursday, June 1st*; but, on our arrival there, we found every preparation so forward, that we had little to do, but to examine, and adjust our respective telescopes to distinct vision. He had fitted up the different instruments, and made a great number of observations, to ascertain the going of his Time-Piece, and to determine the latitude and longitude of his *Observatory*. The laudable pains he hath taken in these material articles, will best appear from the work itself, which he hath committed into my hands, with the following modest introduction; giving me a liberty, which his own accuracy, care and abilities, leave no room to exercise.

Nor-

Norriton, July 18, 1769.

DEAR SIR,

“THE inclosed is the best account I can give of the CON-
 “TACTS, as I observed them; and of what I saw during
 “the interval between them. I should be glad you would contract
 “them, and also the other papers, into a smaller compass, as I
 “would have done myself, if I had known how. I beg you would
 “not copy any thing merely because I have written it, but leave out
 “what you think superfluous.

I am,

With great esteem and affection,

Yours, &c.

DAVID RITTENHOUSE.”

To Revd. Dr. SMITH.

Mr. RITTENHOUSE'S Observations at Norriton, before and
 after the TRANSIT OF VENUS, June 3d, 1769; for fixing
 the Latitude and Longitude of his Observatory, and the
 going of his Clock, &c.

“EARLY in November, 1768, I began to erect an
 “Observatory, agreeable to the resolutions of the AME-
 “RICAN PHILOSOPHICAL SOCIETY; but, thro' various disap-
 “pointments from workmen and weather, could not com-
 “pleat it, till the middle of April, 1769. I had for some
 “time expected the use of an *Equal Altitude* instrument
 “from Philadelphia; but finding I could not depend on
 “having it, I tell to work, and made one of as * simple a
 “construction as I could. March 20th this instrument was
 “finished, and put up out of doors, the Observatory not
 “being yet ready.

* It is described above, No. 4, of the Apparatus.

" I HAD, however, for some weeks before this, with my
 " 36 f. Refractor, observed eclipses of Jupiter's satellites, in
 " such a manner that, tho' my equal-altitude instrument was
 " not finished, and consequently I could not set my time-
 " piece to the true noon, I should nevertheless be able to tell
 " the time of those eclipses afterwards, when the instrument
 " should be ready For this purpose, I observed, almost eve-
 " ry fair evening, the time by the clock, when the bright star
 " in Orion disappeared behind a fixed obstacle, by applying
 " my eye to a small sight-hole, made thro' a piece of brass,
 " fastened to a strong post.

THE Observations were as follows, viz.

1769. Star disap- pear'd. per clock.	Immer. 1st satel. per clock.	Equal altitudes of ☉	Hence ap- par, noon, or ☉'s cent. on Merid.
Feb. D. h. m. sec.	Feb. D. h. m. sec.	Mar. A. M. P. M.	per clock.
15 9. 26. 39	16 11. 24. 58	D. h. m. sec. h. m. sec.	h. m. sec.
22 8. 58. 52	23 16. 17. 41	19 } 8. 58. 52. 2. 56. 52	11. 57. 37
24 8. 50. 57			9. 2. 12. 2. 53. 32
Mar. 3 8. 23. 21	Hence, from co- lumn 3d. the ap- parent times of the 2 immersions above, are,	20 } 8. 56. 40 2. 58. 26	11. 57. 18
12 7. 48. 26			
14 7. 40. 41	Feb. D. h. m. sec.		
17 7. 29. 4	16 4 21. 10		
20 7. 17. 16	23 16. 15. 1		
21 7. 13. 21			
28 6. 45. 44			

" FROM this time, to May 20th, the clock was altered
 " several times; once taken down and cleaned, removed back
 " to the Observatory, and regulated anew. Care was, how-
 " ever, taken to observe *equal altitudes* of the Sun, on the
 " days preceeding and following any visible eclipse of the 1st
 " satellite; when the weather would permit.

" THE whole observations, during this period, were the
 " following.

Equal

Equal Altitudes of ☉ <i>April 3d, 1769.</i>		Hence appar. noon: or ☉'s cent, on Merid. per clock. h. m. sec.	Observed immer- sions of 1st Sa- tellite. <i>April 3d.</i> h. m. sec.
<i>A. M.</i> h. m. sec. 8. 5. 22 8. 8. 16	<i>P. M.</i> h. m. sec. 4. 1. 56 3. 59. 2	12. 3 25	14. 52. 40
4th. 8. 3. 43 8. 6. 38	4. 3. 3 4. 0. 10	12. 3. 9	
10th. 8. 32. 8 8. 35. 6 8. 36. 31	} Cloudy.		10th. 16. 46. 20 Day-Light.
11th. 8. 30. 22 8. 33. 18 8. 34. 41	3. 30. 43 3. 27. 47 3. 26. 22	12. 0. 20	
12th. 8. 28. 55 8. 31. 51 8. 33. 16	} Cloudy.		12th. 11. 14. 38
14th. 8. 25. 42 Cloudy. 8. 30. 2	3. 33. 56 3. 31. 1 3. 29. 37	11. 59. 38	
<i>May 4th.</i> 8. 5. 15 8. 8. 3 8. 9. 23	3. 44. 6 3. 41. 18 3. 39. 58	11. 54. 32	
5th. 8. 4. 11 8. 6. 59 8. 8. 19	3. 44. 51 3. 42. 4 3. 40. 42	11. 54. 22	<i>May 5th.</i> 11. 23. 45
6th. 8. 3. 8 8. 5. 54 8. 7. 15	3. 45. 37 3. 42. 51 - - - -	11. 54. 14	
11th. 8. 34. 51 8. 36. 13 8. 37. 40 8. 39. 3	3. 17. 12 3. 15. 49 3. 14. 22 3. 12. 59	11. 55. 54	
15th. 9. 12. 59 - - - - 9. 15. 53 - - - -	2. 39. 28 2. 38. 2 2. 36. 32 2. 35. 7	11. 56. 7	<i>May 14th.</i> Emerfion. 9. 58. 20

" MAY 20th, in the morning, the clock was set up for the last
 " time, pretty near the mean time. It had no provision for pre-
 " venting the irregularities arising from heat and cold; nor could
 " I find leisure to apply any contrivance of this sort.
 " THIS day I likewise put wires instead of hairs in the telescope
 " of the equal altitude instrument; and the following are the ob-
 " servations, taken both with it, and with the meridian or *Transit-*
 " *Telescope*, in the order wherein they were made.
 " THE ill state of my health would not permit me to sit up at
 " nights, to take equal altitudes of the stars. I was therefore
 " obliged to content myself with those of the Sun only.

1769.		May 20th.			
Equal Altitudes of ☉		Hence ap- par. noon; or ☉'s cent. on Merid. per clock. h. m. sec.	Observ'd E- merfions of ☉'s Satel- lites.	Observations with the Meridian Telescope. h. m. sec.	Hence ap- par. noon; or ☉'s cent. on Merid. per clock. h. m. sec.
A. M.	P. M.				
h. m. sec.	h. m. sec.				
8.1. 30*	3.51. 28			☉ W. limb	
8.2. 52	3.50. 8			on Merid.	11.55.16
8.4. 15	3.48. 45			East Do.	11.57.31
8.5. 36	3.47. 24	11.56. 23½			11.56. 23½
May 21st.					
8.1. 1	3.52. 11		Em. 1st Sat.	☉ W. limb, 11.55. 23	
	3.50. 50		h. m. sec.	E. Do. 11.57. 37	11.56. 30
Clouds. }	3.49. 27	11.56. 30	11.51. 46.	☉ centre	
	3.48. 7			on Merid.	1.18. 39
May 23d.					
8. 0. 4	3.53. 36			☉ W. limb	11.55. 39
8. 1. 24	3.52. 16			E. Do.	11.57. 53
8. 2. 47	3.50. 53	11.56. 45			11.56. 46
8. 4. 8	- - -				
May 24th.					
				☉ E. limb, 11.58. 0	
				—pass. ☉ femidi. 1. 8	11.56. 52
				☉ centre	
				ditto,	1. 2. 4
May 25th.					
7.59 15	3.54. 57			☉ W. limb	11.55. 53
8. 0. 35	3.53. 38			E. Do.	11.58. 9
8. 1. 58	3.52. 15	11.57. 1			11.57. 1
8. 3. 18	3.50. 54				

* In the above Equal Altitudes, it may be proper to observe that those in the after-
 noon are set down in an inverted order, the 4th P. M. being opposite and correspon-
 ding to the 1st A. M. The 1st sett, according to the order in which they stand, is the
 Sun's upper limb at upper hair; the 2d is the upper limb at lower hair; the 3d the
 lower limb at upper hair; and the 4th the lower limb at lower hair, as the telescope
 inverts.

May 26th.

1769.		May 26th.			
Equal Altitudes of ☉		Hence ap- par. noon; or ☉'s cent. on Merid. per clock. h. m. sec.	Observed E- mersions of J's Satel- lites.	Observations with the Meridian Telescope.	Hence ap- par. noon; or ☉'s cent. on Merid. per clock. h. m. sec.
A. M.	P. M.				
h. m. sec.	h. m. sec.			h. m. sec.	
7. 58. 54	3. 55. 38			☉ W. limb 11. 56. 3	11. 57. 10 $\frac{1}{2}$
8. 0. 15	3. 54. 18			E. ditto, 11. 58. 18	
8. 1. 37	3. 52. 56	11. 57. 10			
8. 2. 57	3. 51. 35				
May 27th.					
				☉ W. limb 11. 56. 12	11. 57. 19 $\frac{1}{2}$
				E. Do. 11. 58. 27	
May 30th.					
				☉ E. limb } on Merid. }	20. 20. 31
May 31st.					
7. 57. 29	3. 58. 49			☉ W. limb 11. 56. 58	11. 58. 6
7. 58. 49	3. 57. 30	h. m. sec.		+ pass. ☉ semidi. 1. 8	
8. 0. 11	3. 56. 8	11. 58. 5 $\frac{1}{2}$			
8. 1. 31	3. 54. 49				
June 2d.					
Put smaller wires in the Telescope; hence the dif- ference of the in- tervals.				☉ W. limb 11. 57. 26	11. 58. 33 $\frac{1}{2}$
7. 57. 9	4. 0. 6			E. Do. 11. 59. 41	
7. 58. 29	3. 58. 47	11. 58. 34			
7. 59. 53	3. 57. 22				
8. 1. 13	3. 56. 3				
June 3d.					
TRANSIT DAY. Equal altitudes were not taken this day, as the instrument was to be other- wise employed in the afternoon.				☉ W. limb 11. 57. 41	11. 58. 49
				E. Do. 11. 59. 57	
June 4th.					
- - -	4. 1. 18			☉ W. limb 11. 57. 54	11. 59. 2
7. 58. 10	3. 59. 59	11. 59. 1. $\frac{1}{2}$		E. Do. 12. 0. 10	
7. 59. 34	3. 58. 35				
8. 0. 54	3. 57. 15				
June 5th.					

1769.		June 5th.			
Equal Altitudes of ☉		Hence ap-	Observed E-	Observations with the	Hence ap-
A. M.	P. M.	par. noon ;	merfions of	Meridian Telescope.	par. noon ;
h. m. sec.	h. m. sec.	or ☉'s cent.	☉'s Satel-		or ☉'s cent.
7.56.43	4. 1. 50	on Merid.	lites.		on Merid.
7.58. 3	4. 0. 30	per clock.			per clock.
7.59.27	3.59. 7	h. m. sec.			
8. 0.47	3.57.47	11. 59. 13 $\frac{1}{2}$			
June 6th.					
- - -	2.50. 12		Em. 1st Sat.	h. m. sec.	h. m. sec.
- - -	2.48. 51	11. 59. 26	h. m. sec.	☉ W.limb 11.58. 18	
9.11.30	2.47. 26		10. 11. 2	E. Do. 12. 0. 33	11. 59. 25 $\frac{1}{2}$
June 7th.					
7.57.52	4. 1. 25		Em. 2d. Sat.	☉ W.limb 11.58. 27	
7.59.16	4. 0. 1	11. 59. 36	8. 23. 42	E. Do. 12. 0. 44	11. 59. 35 $\frac{1}{2}$
8. 0.35	- - -			☉ W.limb } on Merid. } 3.21. 53	
June 8th.					
7.56.27	4. 3. 12			☉ W.limb } on Merid. } 11.58.40	
7.57.48	4. 1. 52	11. 59. 48		E. Do. 12. 0. 57	11. 59. 48 $\frac{1}{2}$
7.59.10	4. 0. 28				
8. 0.32	3.59. 7				
June 10th.					
7.56.22	4. 4. 1				
7.57.48	4. 2. 41	12. 0 9 $\frac{1}{2}$			
7.59.12	4. 1. 17				
8. 0.32	3.59. 7				
June 12th.					
				☉ W.limb 11.59.29	
				E. Do. 12. 1.45	12. 0. 37
June 13th.					
7.59.13	4. 2. 30		Em. 1st Sat	☉ W.limb 11.59.42	
8. 0.33	4. 1. 11	12. 0 50	12. 5. 59	E. Do. 12. 1.59	12. 0. 50 $\frac{1}{2}$
June 14th.					
				☉ W.limb 11.59.57	
				E. Do. 12. 2.13	12. 1. 5
June 16th.					
7.56.52	4. 6. 16			☉ W.limb 12. 0. 26	
7.58.12	4. 4. 57	12. 1. 34		E. Do. 12. 2.42	12. 1. 34
7.59.36	4. 3. 33			☉ cent. } on Merid. } 9 6. 4	
8 0 56	4. 2. 12				
June 17th.					

1769		June 17th.	
Equal Altitudes of ☉	Hence ap- par. noon; or ☉'s cent. on Merid. per clock.	Observed E. meridians of ☉'s Satel- lites.	Observations with the Hence ap- Meridian Telescope. par. noon; or ☉'s cent. on Merid. per clock.
A. M. P. M.			
			h. m. sec. h. m. sec.
			☉ W. limb 12. 0. 36 12. 1. 44 8
			+ pass. semid. 1. 8, 8 Therm. } 77°
			☉ centre } 9. 1. 50
			on Merid. } meter
June 19th.			
			☉ W. limb 12. 0. 56 12. 2. 4, 8
			+ pass. semid. 1. 8, 8 Therm. 77°
			☉ c. on mer. 8. 53. 24
June 21st.			
			☉ W. limb 12. 1. 17 12. 2. 25 1/2
			E. Do. 12. 3. 34 Therm. 83°
June 22d.			
			☉ W. limb 12. 1. 28 12. 2. 36 1/2
			E. Do. 12. 3. 45 Therm. 74° 1/2
June 23d.			
			☉ W. limb 12. 1. 39 12. 2. 47
			E. Do. 12. 3. 55 Therm. 73° 1/2
June 24th.			
			☉ W. limb 12. 1. 49 12. 2. 57
			E. Do. 12. 4. 5 Therm. 84°
June 25th.			
		3d lat. out of the shadow, on applying the eye at 8. 54. 39.	☉ W. limb 12. 1. 57 12. 3. 5 1/2
			E. Do. 12. 4. 14 Therm. 80°
June 26th.			
			☉ W. limb 12. 2. 6 12. 3. 14 1/2
			E. Do. 12. 4. 23 Therm. 85°
			☉ E. limb } 18. 13. 52
			on Merid. }
June 27th.			
			☉ W. limb 12. 2. 14 12. 3. 22
			E. Do. 12. 4. 31
			☉ E. limb } 19. 4. 19
			on Merid. }
			☉ c. on mer. 8. 19. 58 Therm. 88°

June 28th.

1769.		June 28th.			
Equal Altitudes of ☉		Hence ap- par. noon or ☉'s cent. on Merid. per clock.	Observed E- clipses of J's Satel- lites.	Observations with the Meridian Telescope.	Hence ap- par. noon or ☉'s cent. on Merid. per clock.
A. M.	P. M.				
h. m. sec.	h. m. sec.			h. m. sec.	h. m. sec.
7.59.11	4.7.45				
8.0.31	4.6.25			☉ W. limb 12. 2. 21	
8.1.55	4.5.0			E. Do. 12. 4.38	
8.3.15	- - -	12. 3. 29.4			12. 3. 29½
June 29th.					
- - -	4.7.43		Em. 1st Sat.		
8.0.48	4.6.22	12. 3. 37	having been	☉ W. limb 12. 2. 29	
8.2.11	4.4.59		hid by a	E. Do. 12. 4.45	12. 3. 37
8.3.32	4.3.38		cloud, at		June 30th.
			h. m. sec.		Therm. 85°.
			10 25. 1		
July 2d.					
8.0.24	4.7.28		Immersion.		
8.1.44	4.6.8	12. 3. 59	3d Satellite.	☉ W. limb 12. 2. 52	
8.3.8	4.4.43		11. 19. 36	E. Do. 12. 5. 8	12. 4. 0
8.4.29	- - -				Therm. 81°½
July 3d.					
8.0.46	4.7.21			☉ W. limb 12. 2. 58	
8.2.7	4.5.58	12. 4. 6		E. Do. 12. 5. 15	12. 4. 6½
8.3.31	4.4.37				Therm. 83°.
8.4.51	4.3.16				
July 4th.					
8.1.9	4.7.13			☉ W. limb 12. 3. 6	
8.2.30	4.5.52	12. 4. 14		E. Do. 12. 5. 23	12. 4. 14½
8.3.53	4.4.31				Therm. 87°
8.5.14	4.3.10				
July 5th.					
8.5.36	4.2.57	12. 4. 19.3		☉ W. limb 12. 3. 11	12. 4. 19½
				+pass. femidi. 1. 8.5	Ther.) at) 94°½ 3 P.M.)
July 8th.					
8.1.36	4.7.41			☉ W. limb 12. 3. 36	
8.2.56	4.6.20	12. 4. 42.½		E. Do. 12. 5. 52	12. 4. 44
8.4.19	4.4.57				Therm. 83°½

TABLE

TABLE of the Eclipses of Jupiter's 1st Satellite, observed at NORRITON, from February 16th to June 13th; compared with the calculated Times of the same Eclipses, for Greenwich, in order to fix the Longitude of the Observatory. The Immersions were observed with Mr. Rittenhouse's Refractor, and the Emersions with the Gregorian Reflector.

1st. Sat. Immersions.				Calculated apparent time of Longitude of Norriton				W. from Greenwich;		
1769. Apparent Time at Norriton.				the same at Greenwich.				thence deduced.		
D.	h.	m.	sec.	D.	h.	m.	sec.	h.	m.	sec.
Feb. 16	14.	21.	10	Feb. 16	19.	22.	29	5.	1.	19
23	16.	15.	1	23	21.	16.	35	5.	1.	34
April 3	14.	49.	25	April 3	19.	51.	24	5.	1.	59
10	16.	46.	0	10	21.	47.	14	5.	1.	14
12	11.	14.	37	12	16.	16.	13	5.	1.	36
May 5	11.	29.	27	May 5	16.	31.	20	5.	1.	53
Emersions.				Emersions.						
21	11.	55.	13	21	16.	56.	49	5.	1.	36
June 6	10.	11.	32	June 6	15.	12.	59	5.	1.	27
13	12.	5.	1	13	17.	6.	31	5.	1.	30

Diff. of Longitude from a Mean of the above 9 Eclipses 5. 1. 34,22 which we must fix for the Longitude of our Observatory, for the present.

But should the observed * times of those Eclipses, come out different at Greenwich from their calculated times in the nautical almanac, for the present year, a correction of the difference of longitude must be made accordingly. OBSER-

* Since drawing up the above, the Revd. Mr. Maskelyne, Astronomer Royal, agreeable to my request, hath been pleased to communicate the following list of Eclipses of Jupiter's 1st Sattellite as observed at the Royal Observatory, from April to June, both inclusive, viz.

1769. Apparent Time; Immersions of 1st Sat. at Greenwich.			
D.	h.	m.	sec.
March 29	12.	25.	7
April 12	16.	16.	8
28	14.	35.	17
Emersions.			
May 16	9.	32.	15
June 8	9.	40.	56
15	11.	35.	33
July 1	9.	50.	24

Mr. Maskelyne writes that the 6 f. Reflector shews an immersion later and an emersion sooner than Short's 2 f. Reflector by about 20"; and that the difference of the 2 f. Reflectors, owing to the difference of their apertures, may be about 5".

There are only three of the above eclipses observed at Greenwich, (viz. the 3 immersions) that could have been seen here, and but one of them happens to be among those actually observed; viz.

April 12th	16h. 16'. 8" at Greenwich.
	11. 14. 37 at Norriton.

Hence 5. 1. 31 Difference of Longitude.

Till we have an opportunity, the ensuing spring, to observe more eclipses of Jupiter's Satellites, we would rather depend on the difference of longitude deduced

OBSERVATIONS for fixing the LATITUDE of Norriton-Observatory, with an Astronomical-Quadrant of two and an half feet radius; made by Sisson.

THIS Quadrant was sent up by Mr. Lukens, and erected in the meridian of the Observatory, May 20th, by Mr. Rittenhouse; who took the following Observations with it; viz.

ZENITH distances of Stars, for discovering whether there might be any error in the instrument.

With the face of the Quadrant westwards.

Highest star in	May 31	20°. 36'. 6"
left leg of Bootes	June 4	20. 36. 0
	5	20. 36. 0
Arcturus	May 31	19. 46. 18
	June 1	19. 46. 14
	2	19. 46. 20
	5	19. 46. 22
Bright star in	June 1	12. 39. 36
the Crown	5	12. 39. 27

With the face eastwards.

Highest star	June 6	20°. 35'. 55"
in left leg	7	20. 35. 54
of Bootes	8	20. 36. 0
Arcturus	June 6	19. 46. 5
	7	19. 46. 8
	8	19. 46. 13
	10	19. 46. 11
Bright star in	June 6	12. 39. 34
the Crown	10	12. 39. 18

FROM a mean of the above 18 Observations, the error of the quadrant is 3".5 to be subtracted from the Zenith distance when the face is westwards, and added when it is eastwards.

OBSERVATIONS of the Zenith Distance of the Sun's upper and lower Limb; and the Latitude of the Observatory deduced from each separately.

☉'s upp. limb à Zen.	Hence Lat.
May 25. 18°. 48'. 45"	40°. 10'. 17"
26. 18. 38. 18	40. 10. 10
27. 18. 28. 21	40. 10. 10
June 1. 17. 43. 47	{ cloudy, and doubtful.
2. 17. 36. 16	40. 10. 2
4. 17. 21. 51	40. 9. 52
doubtful 6. 17. 8. 53	40. 9. 34
7. 17. 3. 21	40. 9. 47
12. 16. 41. 10	40. 10. 14
13. 16. 37. 45	40. 10. 8

☉'s low. limb à Zen.	Hence Lat.
June 8. 17°. 29'. 33"	40°. 9'. 48"
9. 17. 24. 35	40. 9. 47
10. 17. 20. 5	40. 9. 49
11. 17. 15. 59	40. 9. 52
14. 17. 6. 9	40. 9. 53

Mean of the above 9 observations of ☉'s upper limb is, 40°. 10'. 1". 33"

Do. from the 5 observations of lower limb, 40. 9. 50. 48

Mean of both, 40°. 9. 56". 10"
And 39. 56. 54.

Mean of the 5 observations of the lower limb, 40°. 9'. 50". 48"

for the Lat. of Norriton Observatory.
Lat. of Philadelphia Observatory.

deduced from the two foregoing corresponding observations, than on the mean deduced from the calculated times; which, however, puts us only 3" more west. The immersion of April 12th was taken at Greenwich, with Bird's Telescope of 3.8 inches aperture, and the same immersion at Norriton with a Refractor that, in all trials, as near as can be judged, gives the same second with the Gregorian Reflector of 4.4 inches aperture; so that 2" or 3" might be added to the time of the immersion at Greenwich to agree with our Telescope, which would make 5h 1. 33" or 34" diff. long. the same as got from the mean of the calculated times. The eclipses of 2d. and 3d. satellite are not set down, as they are not so much to be depended on, as those of the 1st.

THE difference of the above observations is greater than might be wished. All that can be offered to excuse them is the want of better instruments; though Mr. *Rittenhouse* thinks the differences chiefly arose from the action of the sun on the wooden frame which supported the quadrant. For he always observed that when the shutter in the roof was opened, the plummet-wire would, in a minute or two, leave the point, though it had stood over it quietly all the forenoon. Yet, notwithstanding those differences, a *Mean*, from so many, may be supposed very near the truth; since, if we leave out that of June 6th, which differs most from the others, the mean of the rest will be but 2" greater than it is set down above.

So far I have given Mr. *Rittenhouse's* observations, previous and subsequent to the *Transit*, for ascertaining the going of his time-piece and fixing the latitude and longitude of the observatory, from February 15th to July 8th; by which it will appear what laudable diligence he hath used in these material articles. He hath taken many more observations since; but those given above, are judged fully sufficient to shew that both the latitude and longitude of the observatory may be * depended on, and also the times given on the day of the transit.

It hath been mentioned before, that it was on Thursday afternoon, June 1st, that Mr. Lukens and myself arrived at *Norriton*, with a design to continue with Mr. *Rittenhouse* 'till the transit should be over. The prospect before us was very discouraging. That day, and several preceeding, had been generally overcast with clouds, and frequent heavy rains; a thing not very common for so long a period at that season of the year, in this part of America. But, by one of those sudden transitions, which we often experience here, on Thursday evening, the weather became perfectly clear, and continued the day following, as well as the day of the *Transit*, in such a state of serenity, splendor of sunshine, and purity of atmosphere, that not the least appearance of a cloud was to be seen.

D 2

JUNE

* As the mensuration of the ground between the *Observatories* of Philadelphia and Norriton, will give the same difference both of longitude and latitude, which was got by the different astronomical observations at each place, they may be therefore taken as a confirmation of each other.

JUNE 2d, and the forenoon of June 3d, were spent in making the necessary preparations, such as examining and marking the foci of our several telescopes, particularly the reflector, with and without the micrometer. The reflector was also placed on a polar axis, and such supports contrived for resting the ends of the refractors, as might give them a motion as nearly parallel to the equator as such hasty preparations would admit. Several diameters of the Sun were taken, and the micrometer examined by such other methods as the shortness of the time would allow.

THE Sun was so intensely bright on the Day of the Transit, that instead of using the coloured glasses sent from *England* with the Reflector, I put on a deeply-smoked glass prepared by Mr. *Lukens*, which gave a much more beautiful, natural and well-defined appearance of the Sun's Disk. The smoked glass was fastened on the Eye Tube with a little bees-wax, and there was no occasion to change it during the whole day, as there was not the least cloud, or intermission of the Sun's splendor.

MR. *Rittenhouse*, in his previous projection (see p. 4) had made the first external contact to be, June 3d, 2^h. 11' for lat. 40° N. and long. 5^h. W. of *Greenwich*; on a supposition of the Sun's horizontal parallax being 8". He happened to be very near the truth. For at 2^h. 10' 33" mean time, the 1st external contact was at *Norriton*, lat. 40°. 9'. 56" N. and long. 5^h. 1'. 31" west. Other calculations made it generally from 6' to 8' later for the same latitude and longitude.

THO' this calculation was not given, to be entirely depended on, yet it was sufficient to make us keep what, in the seaphrase, would be called a *good look-out*; and therefore, at one o'clock, we took off the Micrometer, which had been fitted to the Reflector with a power of 95, and adjusted it to distinct vision, with the * same power to observe the CONTACTS. And during

* As the two *Refracting Telescopes*, used by my associates, took into their field but a small part of the Sun's limb, and were difficult to manage on account of their length and the Sun's great altitude, it was thought best that I should not use the greatest power of the *Reflector*; that, having a larger field, I might be able to

during the hour that was to intervene from *one* to *two*, we resolved to keep an alternate watch through the *Reflector*, on that half of the *Sun's* limb, where *Venus* was certainly expected to touch; while the others, not thus employed, were fixing what more remained to be done, as follows, viz.

FIRST, That each of us might the better exercise our own judgment, without being influenced, or thrown into any agitation by the others, it was agreed to transact every thing by signals, and that one should not know what another was doing. The Situation of the Telescopes, the two Refractors being at some distance *without* the Observatory, and the Reflector *within*, favoured this design.

SECONDLY, Two persons, Mr. *Sellers*, one of our Committee, and Mr. *Archibald Mc.Clean*, both well accustomed to matters of this kind, were placed at one window of the Observatory, to count the clock and take the signal from Mr. *Lukens*. Two of Mr. *Rittenhouse's* family, whom he hath often employed to count the clock for him in his observations, were placed at another window to take his signal. My Telescope was placed close by the clock, and I was to count its beats, and set down my own time.

THESE Preliminaries being settled, we prepared at two o'clock to sit down to our respective Telescopes; or (I should rather say) lie down to the *Refractors*, on account of the *Sun's* great height.

As there was a large concourse of the inhabitants of the county, and many from the city, we were apprehensive that our scheme for silence might be defeated, by some of them speaking, when they should see any of the signals

to give notice to them, if the CONTACT should happen at any great distance from that part of the *Sun's* limb where it was expected, and which might not be within their field. But, if it should happen near that part, we were to transact every thing by signals given to the counters at the clock, without the least notice to each other. It was also thought best that there should be some difference in our magnifying powers; and I am well pleased that I did not use a larger with the Reflector, as the vision, with the power I used, was exquisitely distinct and accurate,

for

for the Contacts; and therefore we found it necessary to tell them that the success of our observation would depend on their keeping a profound silence 'till the *Contacts* were over. And to do them justice, during the 12' that ensued, there could not have been a more solemn pause of silence and expectation, if each individual had been waiting for the sentence that was to give him life or death. So regular and quiet was the whole, that, far from hearing a whisper, or word spoken, I did not even hear the feet of the counters, who passed behind me from the windows to the clock; and was surprized when I turned from my Telescope to the clock, to find them all there before me, counting up their seconds to an even number; as I imagined, from the deep silence, that my associates had yet seen nothing of *Venus*.

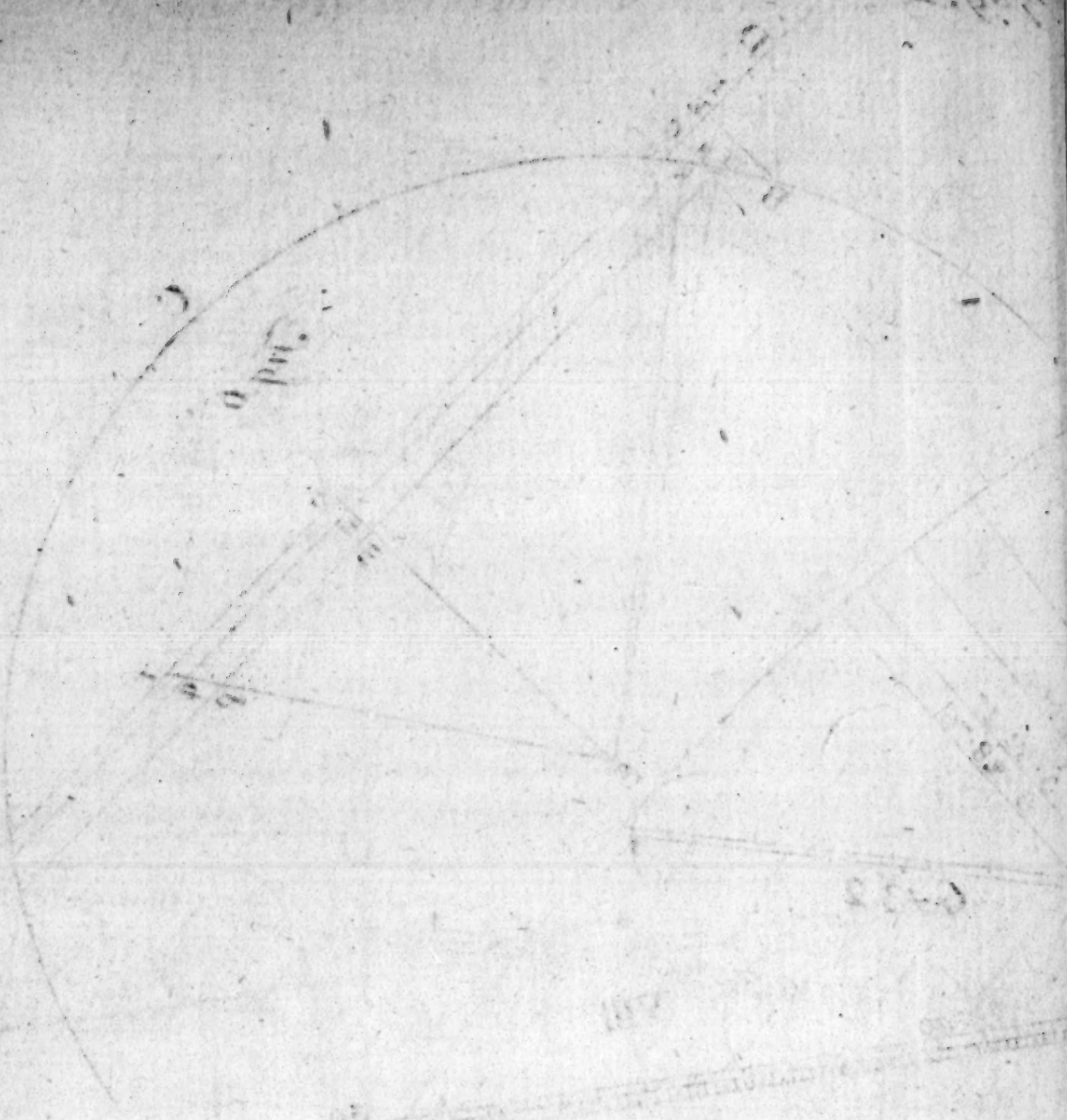
As the CONTACTS are among the most essential articles relative to this phenomenon, it is material, before we set down the *times*, to give a particular account of the manner in which each observer judged of them, and the circumstances attending them.

Mr. RITTENHOUSE's ACCOUNT of the CONTACTS.

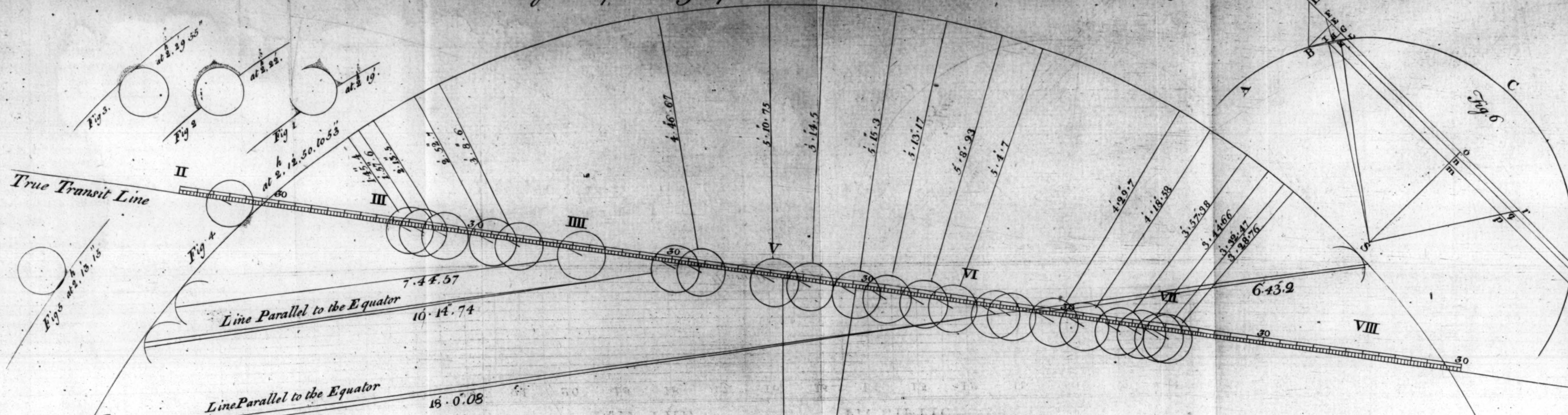
" AT 2^h. 11'. 39" per clock, the Revd. Mr. *Barton* of *Lancaster*, who assisted me at the Telescope, on receiving my signal, as had been agreed, instantaneously communicated it to the counters at the window, by waving a handkerchief; who walking softly to the clock, counting seconds as they went along, noted down their times separately, agreeing to the *same second*. And three seconds sooner than this, to the best of my judgment, was the time when the least impression made by *Venus* on the Sun's limb, could be seen by my Telescope."

" WHEN the Planet had advanced about one third of its diameter on the Sun, as I was steadily viewing its progress, my sight was suddenly attracted by a beam of light, which broke through on that side of *Venus* yet off the Sun. Its figure was that of a *broad-based pyramid*; situated at about 40 or 45 degrees on the limb of *Venus*, from a line passing through her center

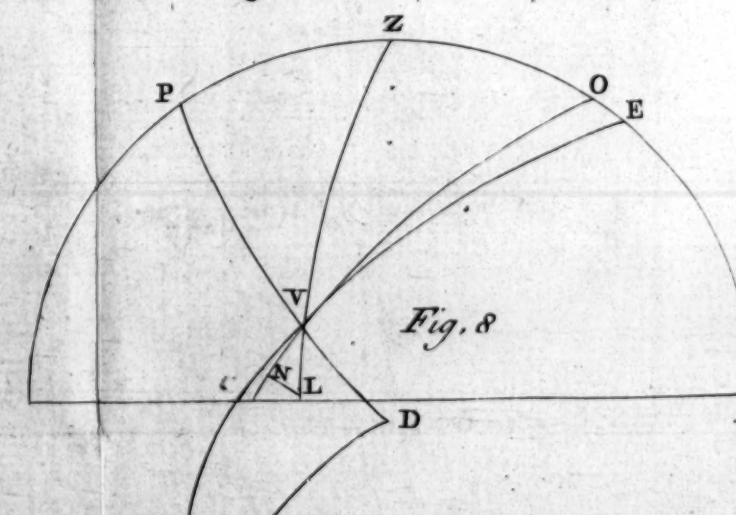
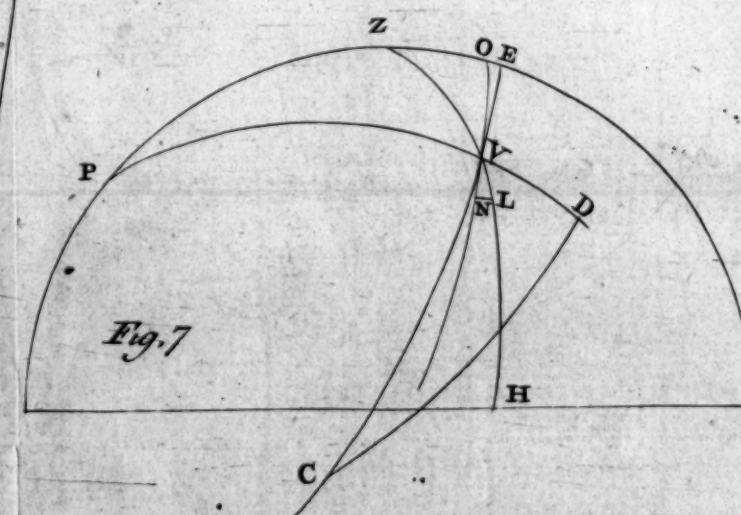
17.14



Projection of the Transit of Venus, over the Sun, as observed at Norriton in Pennsylvania June 3 1769.

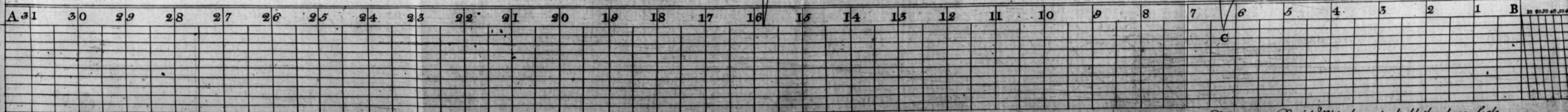


The Phases, Fig. 1, 2, 3, are those noted by M.^r Rittenhouse in his Account of the Contacts. Fig. 4, 5, are the Phases noted by D.^r Smith in his Account; and Fig. 2, 5, are also noted by M.^r Lukens.



AB THE

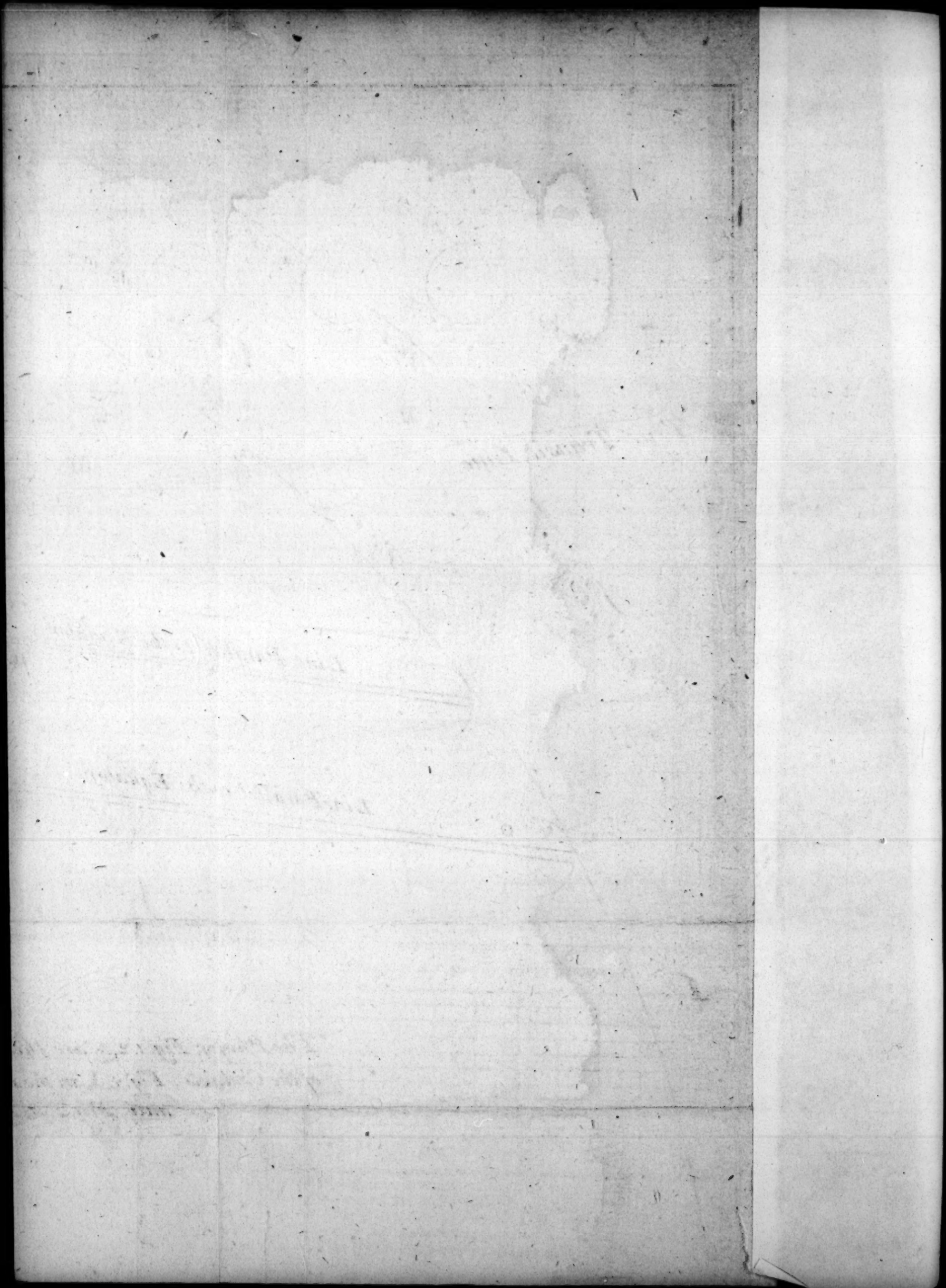
ECLIPTIC



Reduced to this Scale by T. Smith

Henry Dawkins sculp.

Enlarged by David Rittenhouse, to double the above Scale.



center and the Sun's, and to the left hand of that line as seen through my Telescope, which inverted. About the same time, the Sun's light began to spread round *Venus* on each side, from the points where their limbs intersected each other." See a representation of both these phænomena, plate 3. fig. 1.

"As *Venus* advanced, the point of the Pyramid still grew lower, and its circular Base wider, until it met the light which crept round from the points of intersection of the two limbs; so that when half the planet appeared on the Sun, the other half yet off the Sun was entirely surrounded by a semicircular light, best defined on the side next to the body of *Venus*, which continually grew brighter, till the time of the internal contact." See plate 3. fig. 2.

"IMAGINATION cannot form any thing more beautifully serene and quiet, than was the air during the whole time; nor did I ever see the Sun's limb more perfectly defined, or more free from any tremulous motion; to which his great altitude undoubtedly contributed much."

"WHEN the *internal contact* (as it is called) drew nigh, I foresaw that it would be very difficult to fix the time with any certainty, on account of the great breadth and brightness of the light which surrounded that part of *Venus* yet off the Sun. After some consideration, I resolved to judge as well as I could of the co-incidence of the limbs; and accordingly gave the signal for the *internal contact*, at 2^h. 28' 45" by the clock (when the appearance of *Venus* and the border of light were as in fig. 3. plate 3.) and immediately began to count seconds, which any one, who has been accustomed to it, may do for a minute or two, pretty near the truth. In this manner I counted no less than 1' 32" * before the effect of the at-

* Mr. Rittenhouse thinks that a person who had seen the Sun nearer the horizon, and could not so well distinguish between the body of *Venus*, and this surrounding atmosphere, would have been near 1' later than him in pronouncing the contact; and that the other 32" elapsed before the Sun's limb (through the large Refractor he used) appeared totally restored to its former splendor.

mosphere

mosphere of *Venus* on the Sun's limb wholly disappeared; leaving that part of the limb as well defined as the rest. From this I concluded that I had given the signal for the *internal contact* too soon; and the times given by the other observers at *Norriton* confirm me in this opinion."

Mr. LUKENS's ACCOUNT of the CONTACTS.

"THE Telescope I used, being a REFRACTOR of 42 feet, giving but a small field, and something difficult to manage, by reason of the Sun's great altitude; I was obliged to move* often, and apprehend that I did not discover the first impression of the planet on the Sun, which my Telescope would have shewn. For, after one of those movements, on bringing the glass to bear again on that part of the Sun's limb where Venus was expected, I saw a large tremulous shadow, already somewhat advanced, and seeming to press still inwards on the Sun's limb. Having contemplated this for a few seconds, and perceiving the appearance grow more dark, and make a better defined impression on the limb, I gave the signal to the persons who counted time for me, which they noted down separately at 2^h. 12' 3" by the clock. I suppose my telescope might have shewn the impression on the Sun's limb at least 15" sooner.

"WHEN Venus was near one half of her diameter advanced on the Sun, I saw distinctly a border of light encompassing that part of her which was yet off the Sun. This was so bright that it rendered that part of Venus visible and pretty well defined, although not yet entered on the Sun. But towards the *internal contact*, the circular border of light seemed to grow more dusky towards the points where the luminous segments of the Sun's limb were ready to close round the planet. This duskiness did not seem to part wholly from the Sun's limb, at the time I apprehended the body of Venus to be wholly entered on the Sun, and when I gave the signal for the internal contact, which was noted by both the persons who counted for me at 2^h. 28'. 58" by the clock. And I judge at least from 16" to 18" more, before I saw the Sun's limb clear of this dusky shadow."

* The observers with the *Refractors* were obliged to lie on the ground, with their heads bolster'd up by the persons that assisted them.

Dr. SMITH's ACCOUNT of the CONTACTS.

“ THE power kept on the *Gregorian Reflector*, for observing the *contacts*, as hath been already observed, was the same which we had been using, and were again to use, with the *Micrometer*, magnifying 95 times. I had therefore a large field, taking in about half the Sun's Disk; and the instrument was so firmly supported, with its axis in a polar direction, that it could not be shaken by any motion on the earthen floor of the observatory, and required only an easy movement of one part of the rack-work to manage it. With these advantages, any part of the Sun's limb could be readily kept in the middle of the field, without neglecting, every 4" or 5", to cast my eye on all other parts of the limb on both sides, where there was any possibility of the contact to happen.

WITHIN half a minute of the time calculated for the 1st contact by Mr. Rittenhouse, I spoke to the counters at the windows to be very attentive to those who were to give them the signals from the Telescopes out of doors; and turning my eye closely to the part of the Sun's limb where Venus was expected, I had viewed it stedfastly for several seconds, without having occasion to change my field, when I was suddenly surprised with something striking into it, like a watery pointed shadow, appearing to give a tremulous motion to all that part of the limb, although the Telescope stood quite firm, and not the least disturbance or undulation were perceptible about any other part.

“ THE idea I had formed of the *contact* was---That Venus would instantaneously make a well defined black and small impression or dent on the Sun. But this appearance was so different, the disturbance on the limb so ill-defined, undulatory, pointed, waterish, and occupying a larger space than I expected, that I was held in a suspense of 5" or 6" to examine whether it might not be some skirt of a watery flying cloud.

“ PERCEIVING this shadow (atmosphere, or whatever else it was) to press still forward on the limb, with the same tremulous pointed appearance, the longest points towards the
E middle

middle, I began to count the beats of the clock for either 15" or 16", when a well-defined black dent, apparently occupying a less space on the Sun's limb, became distinctly visible. I then quitted the Telescope and turning to the clock, noted the time it then shewed, which was 2^h. 12' 5".

" About 22" sooner than this (viz. the 16" I counted, and the 5" or 6" in which I remained in doubt at the beginning) was the first visible impression on the limb which my Telescope would shew; and I also marked that time down; viz. 2^h. 11' 40" to 43". If this first impression is to be taken for the *external contact*, I think it may be judged of almost to a *single second*, by persons having equally good eyes and Telescopes; which cannot be done, as I apprehend, to *several seconds*; either with respect to the *internal contact*, or even with respect to the moment of the first distinct black dent, commonly marked for the *external contact*. In both these, some differences may well happen among the best observers, from their different manner of judging, in respect to a circumstance of such exquisite nicety.

" WHETHER a Telescope of larger powers than what I made use of, might not have sooner shewn this first shadowy impression (that preceded the distinct black contact) I will not take upon me to determine; though, from the time given by Mr. Rittenhouse, I think it would. But this I can be sure of, that I saw the first stroke of it perceptible through my Telescope, having that part of the Sun's limb in full and steady view; and I might have noted the time to a single second, if I had expected it in that way.

" As to the *internal contact*, the thread or crescent of light, coming round from both sides of the Sun's limb, did not close instantaneously about the dark body of the planet, but with an uncertainty of several seconds; the points of the threads darting backwards and forwards into each other, in a quivering manner, for some space of time, before they finally adhered. The instant of this *adhesion*, I determined to wait for, with all the attention in my power, and to note it down for the *internal contact*; which I did, at 2^h. 29' 5" by the clock; a few seconds later than
Mr.

Mr. *Lukens*, who judged in the same way. And even then, though the points of the thread of light seemed to close, yet the light itself did not appear perfect on that part of the limb till about 12" afterwards; and I apprehend that a person who had waited for the perfection of this small thread of light, would have given the contact that number of seconds later than I did, although I was later than the others."

"AFTER the 1st contact, having quitted the Telescope, to note down my time, the gentlemen who counted for us, and several others now in the observatory, were impatient to see Venus before she had wholly entered on the Sun; an indulgence not to be denied them, as the Reflector was most convenient for them. For this reason I did not sit down to it again till within 5' or 6' of the internal contact, and consequently saw none of those curious appearances, on that part of the planet off the Sun, mentioned by my associates. But their account may be fully depended on, as both of them are well accustomed to celestial observations, and are accurate in judgment as well as sight. The small differences in the times of our *contacts*, it is presumed, may be easily reconciled, from the different powers of our Telescopes, and other circumstances mentioned in the manner of judging. At any rate, we have set them down faithfully.

"As to the first disturbance in the Sun's limb, it may be worthy of consideration, whether it was really from the interposition of the limb of *Venus*, or of her atmosphere. One cannot easily imagine it to be the former, without supposing her limb and body much more ragged and uneven, than they appear when seen on the Sun. An atmosphere is a much more probable supposition, not only from the faint and waterish colour at first, but the undulatory motion above mentioned, which might arise from the growing density of the atmosphere, pushing forward on the Sun, and varying the *Refraction* of his rays, as they pass in succession through it.

"If such an atmosphere be granted, it will probably account for the tremulous motion, in the thread of light creeping round Venus at the *internal contact*; which may be thus prevented from closing and adhering quietly, till this atmosphere

(or at least its densest part) has entered wholly on the Sun, and consequently the co-incidence of the limbs be past. For, though the atmosphere of Venus (as far as we could possibly judge) be not visible on the Sun; yet that part of it which is surrounding, or just entering, his limb, may be visible; having, if I may so express it, a darker ground behind it.

“ But these are only hasty conjectures, submitted to others; although, if they have any foundation, it would make some difference in the time estimated between the *contacts*. And therefore, those astronomers who may happen to be in the world at *another transit*, will perhaps think it best to fix on some general mode of pronouncing with respect to the *contacts*; either by neglecting this atmosphere altogether, or taking their time from the appearance and disappearance of its effects on the Sun's limb. In either case, it is presumed the times of different observers having nearly the same altitude of the Sun, and equal advantages of weather and instruments, would not differ so much as has been the case hitherto, even among eminent astronomers at the same place.”

General TABLE of the CONTACTS of the Limbs of the SUN and VENUS, as observed at Norriton, June 3d, 1769. Reduced to apparent Time.

N B. June 3d, (by the preceeding tables of the work) the Sun's center was on the meridian at 11h. 58. 49" by the clock; and June 4th, at 11h. 59. 2" and therefore gained at the rate of 13" in 24 hours. Hence, at noon June 3d, the clock being 1. 11" slow of apparent time, she was only 1. 9. 48" slow at the external contact, and 1. 9. 40" slow at the internal contact. But to avoid fractions, we say, 1. 10" slow at both contacts. Whence----

The apparent Time of the Contacts, by the different Observers, was—

External Contact, by Dr. SMITH.	External Contact, by Mr. LUKENS.	External Contact, by Mr. RITTENHOUSE.
First visible impression on ☉'s limb, in form of a tremulous pointed shadow, at h. m. sec. 2. 12. 50 to 53	Mr. Lukens changing his Field:	First impression on ☉'s limb, judg'd of as in Plate 3. Fig. 1. at h. m. sec. 2. 12. 49
A well-defined black dent in ☉'s limb, at 2. 13. 15	A small Dent in ☉'s limb, at h. m. sec. 2. 13. 13	
Internal Contact.	Internal Contact.	Internal Contact.
A thread of light, clo- sing round the dark body of ☿ with a tremulous mo- tion, at h. m. sec. 2. 30. 15	Thread of light begin- ning to close round ☿ at h. m. sec. 2. 30. 8	Appearance as in Plate 3, Fig. 3. and judged by him for the Contact, at h. m. sec. 2. 29. 55
The luminous thread become clear and quiet in 12" more, viz. at 2. 30. 27	Thread of light seemed complete, at 2. 30. 24	

WHEN

WHEN Venus was fully entered on the Sun's limb, and we had compared the different papers on which our contacts were written down, and entered them in our book, we prepared for the Micrometer and other observations.

THOSE of the Micrometer, reduced to apparent time, are as follow, viz.

No. of Observations.	Apparent time. June 3d, 1769.	Micrometer measures of least distance of nearest limbs of ☉ & ♀			Value of micromet. measures; or least dist. of limbs, in min. & sec. of ☉'s diameter.	Parallaxes of ♀ from ☉ adjusted to the times of the Micrometer measures, in order to the Projection; by Mr. Rittenhouse.		
	H. M. Sec.	Inches.	20ths.	500ths.	m. sec.	In the Vertical. Seconds.	In Path of ♀ Seconds.	Perpendic to Path. Seconds.
1	3. 7. 19	0.	4.	0,5	1. 45,4	14,54	13,67	4,94
2	3. 11. 39	0.	4.	12	1. 57,6	14,74	13,88	4,96
3	3. 17. 42	0.	5.	2	2. 13,5	15,09	14,24	5,01
4	3. 32. 3	0.	6.	14	2. 52,7	15,77	14,92	5,13
5	3. 40. 4	0.	7.	4	3. 5,6	16,17	15,32	5,23
6	4. 35. 5	0.	10.	21,5	4. 46,67	18,45	17,45	6,01
7	4. 57. 9	0.	11.	19	5. 10,75	19,02	17,95	6,32
8	5. 7. 49	0.	11.	22,75	5. 14,5	19,5	18,36	6,63
9	5. 21. 40	0.	11.	23,5	5. 15,3	19,88	18,64	6,98
10	5. 31. 46	0.	11.	21,5	5. 13,17	20,12	18,8	7,23
11	5. 42. 38	0.	11.	17,5	5. 8,93	20,36	18,95	7,48
12	5. 51. 10	0.	11.	13,5	5. 4,7	20,52	19,06	7,67
13	6. 22. 14	0.	10.	5,5	4. 29,7	21,00	19,21	8,57
14	6. 31. 5	0.	9.	20	4. 18,58	21,12	19,22	8,82
15	6. 41. 24	0.	9.	0	3. 57,38	21,22	19,15	9,14
16	6. 48. 12	0.	8.	13	3. 44,66	21,26	19,12	9,31
17	6. 53. 30	0.	8.	1,5	3. 32,47	21,28	19,04	9,49
18	6. 56. 22	0.	7.	23	3. 28,76	21,29	19,02	9,56

No. of Observ.	Distance of the Limbs of ☉ and ♀ in Chords parallel to the Equator.				Parallaxes, to the times of the micrometer measures		
	H. m. sec.	In. 20ths.	500ths.	M. sec.	Seconds	Seconds	Seconds.
1	3. 58. 53	0.	17.	14,3 E. limb	7. 44,57	17,0	16,1 5,40
2	4. 27. 18	1.	3.	6 E. limb	10. 14,74	18,16	17,18 5,86
3	6. 4. 27	2.	0.	20 E. limb	18. 0,08	20,75	19,16 8,06
4	9. 28	0.	15	6,5 W. limb	6. 43,27	20,81	19,2 8,2

Diameters.

Diameters of ☉ June 3, 1769.						Diameters of ♀ taken on ☉ June 3d, 1769.							
Time per clock.			Micrometer measures.		Value.	Time per clock.			Micrometer measures.		Value.		
A. M.	h.	m.	sec.	In. 20ths.	500ths.	m.	sec.	h.	m.	sec.	In. 20ths.	500ths.	Sec.
	8.	35.	0	3.	11.	13	31. 34,16	3.	0.	0	2.	4,6	56,75
	8.	40.	0	3.	11.	16	31. 37,34	3.	2.	0	2.	5,0	57,18
	8.	45.	0	3.	11.	13	31. 34,16	3.	4.	0	2.	5,25	57,44
P. M.								4.	15.	0	2.	4,7	56,91
	12.	35.	0	3.	11.	13	31. 34,16	5.	55.	0	2.	4,7	56,91
	12.	40.	0	3.	11.	12	31. 33,1	5.	58.	0	2.	5,33	57,53
Mean of the above 5 horizontal diameters of ☉							31. 34,58	Mean of the above 6 for diam. of ♀					57,12
Or leaving out the 2d. which differs most from the rest, & was judged to be taken too large; the mean of the other 4 is							31. 33,89						

Which gives ☉'s semidiameter $15^{\circ}. 46''. 94$; that is, *one second* and $\frac{1}{3}$ of a second larger than the diameter given in the nautical almanack for the transit day. Yet, Venus's diameter, though taken with the utmost care by the same Micrometer and at the same focus (as the Sun's) comes out about one second less than it was expected, being $57''. 12$; or about $\frac{1}{33}$ of ☉'s diameter.

The vertical diameter of ☉ on the same day was $31^{\circ}. 31''. 8$ at $4^h. 40^m$. P. M.

Of the Micrometer measures, the 2d, 5th, and 18th distance of the nearest limbs of the *Sun* and *Venus*; the 1st in a chord parallel to the equator, the 1st and 6th of the diameters of *Venus*; and the 1st and 4th of the diameters of the *Sun*, were taken by Mr. Rittenhouse. The 3d and 16th distance of the nearest limbs, the 3d diameter of *Venus* and the 2d of the *Sun*, were taken by Mr. Lukens. All the other Micrometer measures were taken by myself, while Mr. Rittenhouse applied himself to take the appulses of the limbs of the *Sun* and center of *Venus* to the cross hairs of his equal altitude instrument, Mr. Lukens writing down the observations and their exact time.

THE Micrometer measures were all separately reduced to their value in minutes and seconds by Mr. Rittenhouse, and by myself, making the proper allowance for the error of adjustment

ment of the instrument. Many more Micrometer measures might have been taken; but had we made the intervals between them much shorter than 8 or 10 minutes, they would have been of little use in the projection, and would have crowded it too much. Nor could we have bestowed the same care in setting the instrument, reading off the vernier, &c. if a much larger number had been taken.

In order to judge of the error of the Micrometer (if any) Jupiter's diameter was not only taken with it both ways, viz. to the right and to the left, but Mr. Rittenhouse likewise took a *mean* to the right of 10 diameters of a white painted circle about 330 yards distant, and also a *mean* of as many to the left. This work was performed early in the morning before sun-rise; when the air was free from all tremulous motion; and the result gave an error of adjustment of $1''.12$ to be subtracted from all the micrometer measures.

It was once intended still further to confirm the work of the following delineation, by applying the observations of the ap-pulses of the limbs of the *Sun* and center of *Venus*, mentioned to have been taken above. But the lines necessary for this, would have confused the figure; and the Micrometer observations being found so exact, any further use of the others, than to try how well they would agree, was thought to be needless, especial as the fractions of seconds in them could not be estimated, so as to come up to the accuracy of the Micrometer. For this reason, they are not set down.

Delineation:

*Delineation of the Transit of VENUS over the SUN, according to
the foregoing Observations, with the principles of the work.*

By Mr. RITTENHOUSE.

“THE Sun’s horizontal parallax is assumed $8''.65$ at his mean distance from the earth; from which, and the observed least distance of the centers of the Sun and Venus, the chord of the transit line was laid down. The Sun’s semidiameter and that of Venus are taken as by the above observations. One point in the transit line was then fixed by the first Micrometer distance of the limbs at $3^h. 7' 19''$ apparent time. This line was then divided carefully into hours and minutes, supposing Venus to move $240''.36$ over the Sun’s Disk in an hour, according to a calculation I had formerly made from Halley’s tables. The place of Venus’s center in the transit line, was then marked to the times of each of the observations; and from thence the apparent place of her center found, by setting off the quantity of her parallax from the Sun in its proper direction. About each of the centers so found, a circle is described with the Radius $28''.56$. the observed semidiameter of Venus. Blank lines were next drawn through the Sun’s center and the apparent place of the center of Venus; and on these the black lines were drawn from the Sun’s limb precisely of such length as we found they ought to be by the Micrometer; so that it may be seen at once how far they correspond with each other, by observing how much they exceed or fall short of reaching the limb of Venus.

Out of the 18 Micrometer Observations, there is so exact a correspondence among 14 of them, that I am well convinced they may be depended upon. Two of the others, as will appear by the figure, reach about a *second* over the limb of *Venus*; and the other two are scarce a *second* short of it. Such small differences might easily have happened from the least inaccuracy in reading off the time, or the divisions of the vernier, or from their not being exactly taken in the direction of the nearest distance of the limbs; that is in a line joining the center of the *Sun* and *Venus*.

THE

THE measures intended to be taken in chords parallel to the equator, are likewise exceeding near the truth, if it be considered that in setting the Micrometer to that direction, we had only the truth of the polar axis to depend on, which was constructed hastily to answer the purpose of the Day. Three of these measures agree well with each other, and with all the other Micrometer Observations, on supposing the chord in which they were taken inclined half a degree to the plane of the equator. The 4th is still more nearly parallel, but diverging something the other way. These chords are delineated in the projection, and serve to confirm the other work.

ALL the parallaxes of Venus from the Sun were taken from a projection on a large scale of half an inch to a second, and then reduced to the scale of this delineation. After calculating some of those parallaxes, and finding that those got by the projection came as near those got by calculation, as it was possible to lay them down from the scale; any further nicety was not thought necessary.

The angle of Venus's visible way with the } $8^{\circ}. 28'. 27''$
Ecliptic I find to be

The angle of the ecliptic with a parallel of } $7^{\circ}. 5'. 13''$
declination at 3^h. P.M.

Decreasing $53''$ per Hour.

Latitude of the Observatory (as above) $40^{\circ}. 9'. 56''$

HENCE the parallaxes were fitted to each of the Micrometer Observations, as laid down above. If a computation be made from the first Micrometer Observation of the distance of the limbs, we shall find the time of the least distance of the centers of the Sun and Venus as seen from the Earth's center to have been

If a like computation be made from the 16th } $5^h. 26'. 16''$
Observation it will be found } $5. 26. 21$

By comparing some other observations with these I conclude the time of least distance of the centers to have been

$5^h. 26'. 20''$

F

THEN

THEN say, as Radius is to the tangent of the angle of *Venus's* visible way with the ecliptic; so is the least distance of the centers, to that portion of the path, intercepted between the place of *Venus* at the time of the least distance of the centers, and her place at the time of ecliptic conjunction; that is---

Rad: T. $8^{\circ} 28' 27''$:: $610''$: $90'' 88$.

But $90'' 88$ reduced to time is - - $0^h 22' 41''$

Time of least distance of centers is - $5. 26. 20$

Difference of which is the time of } $5^h 3' 39''$
ecliptic conjunction

Again Rad: sec. $8^{\circ} 28' 27''$:: $610''$: $616'' 73$; the geocentric latitude of *Venus* at the time of ecliptic conjunction.

From the logarithm of *Venus* geocent. lat. 2. 7900974

Subtract the diff. of the logarithms of

Venus's distance from the Earth and } $0. 4002370$
from the Sun

Remains the log. of the heliocentric lat. 2. 3898604 = $4^{\circ} 5' 39''$

THEN say; as the tangent of the inclination of the orb of *Venus*, is to Radius, so is the tangent of her heliocent. lat. to the sine of her distance from the node in the ecliptic; that is---

T. $3^{\circ} 23' 20''$: Rad :: T. $4^{\circ} 5' 39''$: Sine $1^{\circ} 9' 4''$
the distance from node.

THE *Sun's* place, by Halley's tables at time } $2^s 13^{\circ} 26' 32''$
of ecliptic conjunction was

Distance of the node from the Sun - $0. 1. 9. 4$

The Sum is the place of *Venus's* ascending } $2. 14. 35. 36$
node

But, by Halley's tables, the place of *Venus* } $8. 13. 26. 22$
to the above time is only

That is TEN SECONDS too slow.

THUS, Gentlemen, you have a faithful account of our whole work, which we could have wished to have reduced to less compass. Had our latitude and longitude been previously fixed, as they had been at Philadelphia by able mathematicians, a great part of our work might have been saved. But we thought it necessary (as hath been before hinted) to shew that such pains were taken in these material articles that they may be

be depended on. And as we were happily favoured at the transit, with advantages of weather, and other circumstances, which cannot have happened to the generality of observers in many parts of the world, it was thought we should be more readily excused, by men of science, for the insertion of things that might be superfluous, than the omission of the least article material, in the account of a phenomenon, that will never be observed again, by any of the present generation of men.

I am,

Gentlemen, with great respect,

Your most obedient humble servant,

Philadelphia, July
19th, 1769.

WILLIAM SMITH.

THE reader is desired to make the following correction of the equal altitudes of April 11th and 14th, as that part of the work was printed off before the mistake was discovered.

April 11th.	A. M.		P. M.		Hence ap- par. noon, per clock. h. m. sec.	April 14th.	A. M.		P. M.		Appar. noon per clock. h. m. sec.			
	h.	m.	sec.	h.			m.	h.	m.	sec.		h.	m.	sec.
	8.	30.	32	3.			30.	8.	25.	42		3.	33.	56
	8.	33.	28	3.			27.	-	-	-		3.	31.	1
	8.	34.	53	3.	26.	12.	8.	30.	2	3.	29.	11.	59.	37

which gives 1". to be subtracted from, instead of being added to, the observed time of the immersion of 1st satellite, April 12th, and makes it 11^h. 14'. 37" (as it stands corrected in the table of eclipses of the satellites) instead of 11^h. 14'. 39", as it would be deduced from the altitudes printed above for April 11th, compared with those of April 14th.

The Emer. of 2d Sat. per Clock, June 7th, is also to be read, 8^h. 43'. 29", instead of 8^h. 23'. 42".

P. S. As it is hoped that not only this province in general, but likewise the Society who set on foot, and the honorable House of Assembly, who so liberally encouraged, the design for observing the Transit here, may derive some credit from the laudable spirit shewn on that occasion, I shall add an extract of a letter from the Revd. Mr. Maskelyne the Astronomer Royal, to shew how well our labors have been received at home.

Greenwich, August 2d, 1769.

S I R,

" I Thank you for the account of the Pennsylvania Obser-
 " vations (of the Transit) which seem *excellent* and *compleat*;
 " and do honor to the gentlemen who made them, and those
 " who promoted the undertaking; among whom I reckon
 " yourself in the first place.

" As soon as I can settle the longitude of their places of
 " observations, with respect to this place, I hope to be able,
 " from comparing them with my own, and other European
 " observations, which I have already received, to find the
 " SUN'S PARALLAX, nearer than we could depend on it from
 " the *Transit* in 1761.

" I do not yet know whether the Observations made by
 " Messrs. Mason and Dixon in Pennsylvania will suffice to
 " settle the longitude of Philadelphia, to the exactness here
 " requisite. I wish, therefore to receive the observations of
 " the eclipses of Jupiter's satellites, made there in the spring
 " of this year, of which Dr. *Smith* makes mention. Those
 " which have been made here, I have set down on the * next
 " page; and request you will be pleased to send them to him,
 " with my best compliments and congratulations on his and
 " his fellow-Observers successful labors. I wish also to have
 " an account of the difference of latitude and longitude between
 " the *Philadelphia Observatory*, and the two other *Observatories*
 " at *Norriton* and the *Capes of Delaware*; and also how much
 " the *State-House* square differs from the southermost point of
 " the city of Philadelphia, to which Messrs. Mason and Dixon
 " have referred their observations.

" WHEN you receive any further account of the Pennsylv-
 " nia Observations, promised by Dr. Smith, or any other
 " American Observations, I shall be obliged to you for a sight
 " of them.

" I BEG you will accept of the enclosed account of my ob-
 " servations of the Transit, and of the eclipse of the Sun,

* They are inserted above at the bottom of Page 21.

" June

“ June 3d. You will perceive that several phenomena noted
 “ at *Norriton* agreed with those observed here ; but they have
 “ further observed a curious circumstance at the first entrance
 “ of Venus, which the low altitude of the Sun did not permit
 “ me to observe here ; as, on the other hand, some phænomena
 “ were noted here, which they have not taken notice of.

“ In a few days I will do myself the pleasure to leave some
 “ of my pamphlets with you, which I beg you would send to
 “ the Pennsylvania Observers, when you have an opportunity.

I am,

S I R,

Your very humble Servant,

NEVIL MASKELYNE.”

To the hon. THOMAS PENN, *Esq*;

THE above letter was occasioned by a short account I had sent to Mr. PENN four days after the Transit, informing him of the success of our observations, the times of the contacts, and a few other circumstances attending them ; which he communicated to Mr. Maskelyne. Since that, Mr. Maskelyne has received full satisfaction on all the points mentioned in his letter, as compleat copies of our different observations have been transmitted to Dr. Franklin, to communicate to him, and such other astronomers as he may think proper among his correspondents in Europe. The particular circumstances which I mentioned relative to the first entrance of Venus, was the dusky tremulous shadow or atmosphere that seemed to precede her body, and the light that surrounded that part of her limb not entered on the Sun, which was also observed by the gentlemen at Philadelphia, and by Mr. Biddle at the Capes. Which of these, or whether both, may be the curious circumstance, or circumstances, observed here, which Mr. Maskelyne says the low altitude of the Sun did not permit him to observe, we cannot tell ; as his account of the Greenwich Observations has not yet come to hand.

W. S.

An

An Account of the OBSERVATIONS on the TRANSIT OF VENUS over the SUN, on the 3d of June, 1769, by the COMMITTEE appointed to observe it at Philadelphia; drawn up, and presented to the AMERICAN PHILOSOPHICAL SOCIETY, held at Philadelphia, for promoting useful Knowledge,

By JOHN EWING.

GENTLEMEN,

IT doubtless must appear strange to many, that the parallax of the Sun, which is so important and fundamental an article in Astronomy, has not been settled by Astronomers long ago, as so many things in that useful Science depend upon it. But this surprise is lessened by considering, that the smallness of the parallactic angle has eluded their most careful researches in all ages, as it is but about 8 or 9 seconds of a minute; so that the subtense of it, were it much larger than it is, must be invisible to the naked eye at the distance of 6 inches, and it is hardly possible to distinguish 10 seconds by instruments, let them be ever so skillfully made. Many methods have been devised by Astronomers, which shew the ingenuity of the inventors; but the disadvantage of them all was, that they depended upon observations to be made with a precision, which no instruments hitherto constructed could possibly accomplish. The Transits of Venus alone afford an opportunity of determining this problem with sufficient certainty, and these, from the strict laws of her motion, happen so seldom, that there cannot be more of them than two in one century, and in some centuries none at all. Three only have been observed since the creation, and the first of them by two persons only. The peculiar advantage of this phenomenon for determining the parallax of the Sun with a precision which is not to be expected from any other method, consists in its being deduced from the absolute time that elapses between the instants of the contacts with the Sun's limb, as seen from different parts of the earth; or from the difference of total durations as noted by distant observers, properly stationed for that purpose. A second of time being easily distinguished by a well regulated clock, if the aforelaid absolute difference of
time

time be carefully noted, in places where it will amount to 24 minutes, it will give the parallax, small as it is, within the hundredth part of a second of a degree, and consequently the distance of the Sun and planets within the seven hundredth part of the whole. In some Transits this difference of time will be greater, and in others less, in certain places on the earth, which renders those that happen on the northern part of the Sun's disc, in general, more favourable to our purpose, than those that happen on the southern hemisphere. Hence it is, that altho' much was done in this matter by the sedulity and care of Astronomers at the Transit in the year 1761, when Venus passed south of the Sun's center, yet our expectations could not be fully answered by the observations that were then made; as it was easily foreseen that much greater precision might be attained, from the advantageous circumstances that would attend the Transit in 1769. The great proficience, which the Astronomers made in settling this fundamental element, beyond what was ever known before, has only raised their expectations and engaged their attention to improve every advantage, that can be derived from a careful observation of this Transit. If they have not been disappointed by unfavourable weather, we hope for the utmost certainty that can be gained in this matter, from the Observations they have made, when they shall be compared together. But after all, we must sit down with the disagreeable assurance that the distance of the Sun cannot be determined by them, let them be made with ever so great accuracy, within many thousand miles; which will not appear strange, when we consider that his distance is upwards of 94 millions of miles, and that an error of a single second in his parallax will give an uncertainty of 10 or 11 millions of miles in his distance.

THIS approximation, however, is so much greater than could be expected, from any other method, that has ever been proposed, that it has deservedly engaged the attention of every civilized nation in the world; and it must redound to the honor of our Society, that they have taken such effectual care to have proper Observatories erected, to furnish them with the necessary instruments, and to appoint proper persons, to use them on that occasion.

As

As the credit of our Observations, and the stress that will be laid upon them, in determining the parallax of the Sun, will greatly depend not only on the care and skill of the persons that made them, but also on the goodness of the instruments, with which we were furnished; it has been judged proper to give the public the following account of our apparatus, and of the pains we have taken to have it in the best order.

As the Society were pleased to appoint *Joseph Shippen, Esq;* *Dr. Hugh Williamson, Mr. Charles Thomson, Mr. Thomas Prior,* and *Myself,* as a Committee to observe the Transit at the Observatory, which they had erected in this city, we spared neither time nor labor to have every thing necessary for the Observation in readiness. We were provided with an excellent Sector of 6 feet radius, made by the accurate Mr. Bird, and an Equal Altitude and Transit Instrument, both belonging to the honorable Proprietaries of this province, which the Governor very generously lent to the Society on this occasion. Our Telescopes were, a large Reflector of 4 feet focus and 7 inches aperture, which magnified from 100 to 400 times with an excellent Micrometer of Mr. Dollond's construction fitted to it, which the Assembly of the province had ordered over at the request of the Society; a Refracting Telescope of 24 feet focus, belonging to Miss Norris; two Reflecting Telescopes of 18 inches focus, one the property of Mr. Hamilton, the late Governor of this province, and the other of Mr. Prior, together with another Reflector of 12 inches focus. With these, and a good time-piece, we promised ourselves the pleasure of making accurate Observations, if the weather should prove favourable. For this purpose we met frequently before the Day of the Transit, to adjust our instruments, and to remove every local obstruction that might hinder our Observations.

SOME of us gave particular attention to the regulation of the time-piece, and therefore took the passage of the Sun's limbs over the cross hairs of the Transit-Instrument, both forenoon and afternoon for many days before and after the Transit, and particularly on that day. As it had 3 horizontal hairs fixed in the focus, it afforded us 6 sets of corresponding altitudes, which generally

generally agreed in giving the time of apparent noon within 2 seconds of each other ; so that by comparing them together daily, and applying the proper equations for corresponding altitudes, on account of the Sun's change of declination between the forenoon and afternoon Observations, we were assured of the rate of our clock's going and the time of apparent noon to a single second. We did not think it necessary to burden our minutes, with the great number of Observations of this kind, that we made. Let it suffice to say, that they were made with the utmost care, and that our time piece was fixed to a large post sunk into the ground four or five feet, secured from shaking by a brick wall at the bottom, and no ways communicating with the sides of the building.

THE long expected Day of the Transit came, so favourable to our wishes, that there was not the least appearance of a cloud in the whole horizon from morning till night, and the sky was uncommonly serene. The Committee assembled in the morning at the Observatory, examined the adjustment of their Telescopes anew, and appointed two assistants to observe the clock, one to count the seconds with an audible voice, and the other to write down the minutes as they were compleated, to prevent a mistake in that article.

EVERY Observer being fixed at his Telescope, at least half an hour before the beginning of the Transit ; we observed the contacts of the limbs of Venus and the Sun at the times mentioned in the following accounts, as they were drawn up separately by the Observers themselves, and are here inserted in their own words.

Account of the CONTACTS, by JOSEPH SHIPPEN, Esq;

“ I OBSERVED this very uncommon and curious Phænomenon
 “ with a new Reflecting Telescope, made by Mr. George
 “ Adams, whose tube is two feet and half an inch long, its
 “ aperture 4,15 inches diameter, and its magnifying power
 “ about 90 times. After having well adjusted its focal distance,
 “ the Sun's limb appeared so well defined, that the least ob-
 “ scuration of it might be clearly discerned by a good eye.

" IN order to discover the first external contact, as near the
 " precise time of its happening as possible, I kept constantly
 " in the field of the Telescope, but a small arch of the Sun's
 " limb, and only that part of it, where it was expected the
 " Planet would enter; by which means I believe I saw the
 " obscuration on the limb of the Sun as near the exact time of
 " its beginning as the power of the Telescope would admit of.

" THE first alteration which I perceived in the Sun's disc,
 " was a *jagged like appearance* on a small arch of the limb; as
 " if a shadow had been cast on it with an *irregular notched edge*,
 " which, at every second, seemed to increase with a kind of
 " waving and tremulous motion. I first perceived this change
 " at 2^h. 13'. 47" ap. time, though I was not then convinced
 " that that appearance was, either the Phænomenon we looked
 " for, or caused by the Planet's near approach to the Sun's
 " limb; but imputed it rather to some dust that might acci-
 " dentally have fallen on the large mirror of the Telescope,
 " as I expected the contact would have shewn itself by one
 " small arched *indent* on the Sun's limb. And it was not till
 " after 12 seconds more had passed, that I was certain the
 " contact had happened; for then, viz. at 2^h. 13'. 59" ap.
 " time, I could plainly distinguish a single impression, or in-
 " dent, in the Sun's limb; yet it was exceedingly small, and
 " without any of the *jagged appearance* before mentioned.

" I CANNOT well account for these different appearances in
 " so small a space of time, but by supposing that the first was
 " occasioned by an atmosphere around the body of Venus,
 " which might have obscured, in a small degree, part of the
 " Sun's limb, a few seconds before the contact; and that after
 " Venus herself had actually entered on the Sun's limb, the
 " brilliancy of the Solar rays might have so far illuminated the
 " atmosphere of Venus, as to cause the obscuration at first
 " perceived to disappear, and leave only the well defined
 " form of the planet on the Sun's disc.

" ON considering the matter in this view, I am inclined to
 " think that the first external contact did not really happen
 " till

" till at least 3 seconds after I first perceived the jagged obscuration on the Sun's limb; and then it would be at 2^h. 13'. 50" ap. time.

" BUT if Astronomers agree to fix the time of the first contact at the beginning of that obscuration, I think it is probable the contact may have happened two or three seconds before I discerned that obscuration: In which case, the contact may be said to take place at 2^h. 13'. 44" ap. time.

" IN determining on the manner in which I should judge of the *Internal Contact*, I considered that after Venus should move on the Sun's disc with half her diameter, the horned points occasioned thereby in the Sun's limb would appear more acute, and approach nearer to each other as the planet proceeded till the points should actually unite. From this reflection I was induced to think, that the instant of the closing of those points ought to be fixed on as the precise time of the internal contact; because Venus must then have passed the Sun's limb with her whole diameter, and both their circumferences, or limbs, might be said to coincide.

" I THEREFORE carefully observed the progress of the Planet, and saw very distinctly, as she moved onwards, that the illuminated points of the Sun's limb became better defined; and when they approached so near each other as to be within about 8 seconds of touching, which was at 2^h. 31'. 26" ap. time, I heard one of the Observers call out, *Contact*; but as his observation did not seem to agree with the manner which I had fixed for judging of the contact, I continued viewing with the closest attention, in order to fix the time of contact according to the idea I had formed of it; and at 2^h. 31'. 34" ap. time I could scarcely distinguish the illuminated points of the Sun's limb to be any longer separate; for in two seconds more they appeared to be so far closed as to form a single thread of light on that part of the Sun's limb, which a few seconds before had been eclipsed. I therefore conclude that the *apparent* first internal contact of Venus happened at 2^h. 31'. 34" ap. time. Yet it is

" not improbable that her *real* Contact may have happened a
 " few seconds sooner, if it be certain that she has an *At-*
 " *mosphere* ; because *that* might have obscured the Sun's limb
 " a few seconds after Venus was entirely immersed within the
 " disc ; in the same manner as I judged with respect to the
 " external Contact, that the beginning of the Obscuration of
 " the Sun's limb was occasioned by the intervention of the
 " atmosphere of Venus a few seconds before her body actually
 " came in contact with the Sun."

Account of the CONTACTS, by Dr. WILLIAMSON.

" I MADE use of a Refracting Telescope 24 feet long, which
 " magnifies ninety times. The glasses were in very good or-
 " der, and the air uncommonly serene, so that the Sun's limb
 " appeared very distinct and well defined, whence I promised
 " myself the pleasure of fixing the external contact to a second,
 " but the event convinced me that I had promised too much.
 " A dusky appearance once and again drew my attention to a
 " particular part of the Sun's limb, but I could see no such
 " dark spot there as I thought Venus must produce, and it
 " was not till 2^h. 11'. 31" mean time, or 2^h. 13'. 46" apparent
 " time, that I determined to stop a watch which I had in my
 " hand, to ascertain the time of my Observation, lest some
 " accident should prevent my hearing the assistant, who stood
 " at 5 or 6 yards distance by the clock counting seconds. At
 " that very time I was doubtful, whether the appearance on
 " the limb of the Sun was certainly occasioned by the inter-
 " position of the body of Venus ; for tho' the darkness was of
 " some extent along the Sun's limb, yet the impression was
 " not proportionably deep, supposing that it was made by
 " a circle so small as Venus compared with the diameter of
 " the Sun, nor was the darkness equally perfect ; yet the sub-
 " sequent progress of the darkness soon convinced me that I
 " had not been much too hasty in noting the time of the exter-
 " nal contact.

" WHEN Venus had advanced with a little more than half
 " her body on the Sun, her whole eastern limb appeared faint-
 " ly

“ ly illuminated : This light seemed to encrease as she advanced farther on the Sun, till near the time of the internal contact. By this time I was convinced that Venus is surrounded by a dense atmosphere of a considerable height, which doubtless had prevented my fixing the external contact, with that accuracy I had expected, and had occasioned that inequality in the darkness, which I had observed on the Sun’s limb.

“ In determining the internal contact, which I apprehend was done with great exactness, I attended to the instant, when there was a perfect coincidence of the limb of Venus with the limb of the Sun, as when two circles touch internally. This appeared at 2^h. 31’. 24^u apparent time. I expected by the time the assistant had counted another second, to have seen light distinctly round the eastern limb of Venus ; not such a radiance as had for 7 or 8 minutes rendered that part of the planet visible ; but a certain narrow portion of the Sun’s limb which had a very distinguishable appearance from the light I have mentioned. The edge of the Sun did not appear so soon ; nevertheless I fixed upon 2^h. 31’. 25^u for the precise time of the internal contact, being certain, that no part of Venus was then off the Sun. One or two seconds more were counted before the Sun appeared distinctly without the limb of Venus. But then it was obvious that Venus did not then touch the Sun’s limb in any part, so that the contact was certainly over.”

MR. PRIOR made his Observations with his own Reflecting Telescope, whose magnifying power he does not certainly know, but supposes it to be at least an hundred times. He gave the following account of his Observation of the Contacts, viz.

“ THE uncertainty where Venus would touch the Sun’s limb made me take the following method. From 8 or 9 minutes past two o’clock I made it a rule to pass my eye from the lower edge of the field of my Telescope to the upper, many times in a minute, and examine the limb of the

“ the Sun strictly, in hopes of discovering the atmosphere of
 “ Venus approach, so as to give an opportunity of taking the
 “ contacts of the limbs to a great certainty. In passing my
 “ eye along the limb of the Sun, I discovered a small imper-
 “ fection, which I thought must be the stroke of the at-
 “ mosphere, but in four seconds I discovered it to be the limb
 “ of Venus, the atmosphere not being visible on the Sun.
 “ The time therefore that I note for my external contact is,
 “ when I first discovered that imperfection on the Sun's limb,
 “ which was at 2^h. 13'. 42" apparent time. When the body of
 “ Venus was something more than one third on the Sun, I saw
 “ her eastern atmosphere very distinctly reflecting the light of
 “ the Sun so strongly on the limb of Venus, as to shew it well
 “ defined; but as it came on the Sun, it was entirely lost.
 “ The time, I note for my internal Contact, was, when the
 “ thread of light was distinctly seen all round the body of
 “ Venus, which was at 2^h. 31'. 28" apparent time.”

MR. JAMES PEARSON having observed the external
 Contact at 2^h. 13'. 50" apparent time, with a small Telescope,
 belonging to the honorable Proprietaries of this province,
 whose magnifying power is about 60 times; Mr. CHARLES
 THOMSON observed the internal contact with the same
 Telescope, of which he gave the following account, viz.

“ AT 2^h. 29'. 11" mean time, or 2^h. 31'. 26" apparent
 “ time, I saw some tremulous rays of light pass from the up-
 “ per or eastern limb of the Sun to the eye, across, and so as
 “ just to touch the upper limb of Venus. Marking that down
 “ therefore as the time of Contact, I counted four seconds, at
 “ which time I saw a continued thread of light, like a silver
 “ lace, but still with a tremulous motion, round the eastern
 “ limb of Venus, whereby it appeared to me that the whole
 “ body of Venus was then within the disc of the Sun. The
 “ tremulous appearance of the rays of light, I at first attri-
 “ buted to my Telescope resting against the side of the Ob-
 “ servatory, but afterwards apprehended might be owing to
 “ their passing thro' the atmosphere of Venus.”

THE

THE Committee having desired me to use the large Reflector abovementioned, I chose that power which magnifies the diameters of objects 300 times; with which I observed at 2^h. 13'. 48" apparent time, an obscuration on the north-eastern limb of the Sun, gradually advancing forwards with a tremulous motion, which from its irregular and dusky appearance, I concluded was occasioned by the refraction of the Sun's rays thro' the atmosphere of Venus, which atmosphere soon afterwards became very observable to us all. From this I was led to conclude that the Contact did not happen till about 15 or 16 seconds afterwards, when there was a large and evident impression made on the limb of the Sun; but as the precise moment of the external Contact cannot be noted by an Observer, the body of Venus not yet being interposed between the Sun's limb and the eye; this Contact must have happened about the time that her atmosphere made the abovementioned obscuration, and therefore I am of opinion that the true time of the Contact should be accounted at 2^h. 13'. 48", or it may be 3 or 4 seconds sooner, when nothing but the atmosphere of Venus, which preceded her body, appeared on the limb of the Sun. About the time that the center of Venus approached the Sun's disc, I saw the whole body of Venus, her eastern edge being surrounded with a faint light, which was doubtless occasioned by her atmosphere refracting the Sun's rays. At 2^h. 29'. 11" mean time, or 2^h. 31'. 26" apparent time, I saw the internal contact, when the whole body of Venus was introduced within the disc of the Sun, and the thread of light had compleatly surrounded her, altho' not as bright as it became in two seconds afterwards.

FROM what has been said, it appears that the apparent times of the Contacts may be represented at one view in the following table, as they were noted by the different Observers.

	1st Exter. Contact.	1st Inter. Contact.	Magnifying Powers.
	h. m. sec.	h. m. sec.	
<i>Joseph Shippen, Esq;</i>	2. 13. 47 Ap. T.	2. 31. 34 Ap. T.	80 times.
<i>Dr. Williamson,</i>	2. 13. 46	2. 31. 35 to 27	90 times.
<i>Mr. Pearson,</i>	2. 13. 50	- - - - - }	60 times.
<i>Mr. Thompson,</i>	- - - - -	2. 31. 26 to 30 }	
<i>Mr. Prior,</i>	2. 13. 42	2. 31. 28	100 times.
<i>Myself,</i>	2. 13. 48	2. 31. 26	300 times.
A well-defined black dent in ☉'s limb, at	2. 14. 3		AFTER

AFTER the Observation of the Contacts, I applied myself to the Micrometer to measure the diameters of the Sun and Venus, and the distance of their limbs at sundry times during the Transit. I had indeed frequently measured the equatorial diameter of the Sun before the Day of the Transit, and always found it to be 6 seconds less than what is given in the Nautical Almanac. The mean of 6 measures on that day is $31'. 31''.6$, which differs but $0''.3$ or three-tenths of a second from what is given in the said Almanac lessened as above. Therefore I have stated it at $31'. 31''.3$ in the following reductions and calculations.

Six measures of the diameter of Venus on the Sun made it 58 seconds. I attempted to measure it both ways, with the beginning of the divisions of the vernier advanced on the scale of the Micrometer and the contrary, that the error of adjustment might have been thereby taken away. But the Micrometer did not admit of it, the diameter of Venus being a small matter too large for this operation. However I took some measures this way, but they gave the diameter no more than $55''.4$, which appearing too small were therefore rejected.

ABOUT 20 minutes after the Contacts, I began to measure the nearest distance of the limbs of Venus and the Sun, and continued untill the Sun was so low, that the measures could not be made with sufficient accuracy any longer. Some of the measures appear to disagree too much with the others, and therefore should not be depended on; but I could not prevail upon myself to neglect the inserting of them; least the unusual agreement among so great a number should raise a suspicion in the minds of Astronomers that they had not been honestly transcribed from our minutes; especially as there are enough to answer all the purposes designed by them, which agree in giving the nearest distance of the centers with sufficient precision. Although these measures are set down in the following table with the parts of a second, we would not therefore be supposed to affect an impossible accuracy in them, but they are such as the Micrometer has given them when properly reduced.

Mean

No. of Obser.	M. Time. 1769. June 3d,			Ap. Time.			Nearest dist. of the limbs of ☉ and ♀	Nearest distance of their cen- ters.	Par. of ♀ in the Ver- tical.	Par. of ♀ in her Path.	Par. of ♀ perpen- dic. to her Path.
	h.	m.	sec.	h.	m.	sec.	m. sec.	m. sec.	sec.	sec.	sec.
1	2.	53.	43	2.	55.	59	1. 8,46	14. 8,19	13,95	13,20	4,56
2	3.	5.	51	3.	8.	7	1. 48,23	13. 57,42	14,60	13,9	4,64
3	3.	11.	32	3.	13.	48	2. 4,49	13. 12,16	14,92	14,20	4,68
4	3.	14.	17	3.	16.	33	2. 10,4	13. 6,25	15,05	14,3	4,70
5	3.	22.	7	3.	24.	23	2. 24,77	12. 33,07	15,50	14,70	4,78
6	3.	25.	45	3.	28.	0	2. 33,25	12. 34,3	15,70	14,90	4,86
7	3.	27.	37	3.	29.	52	2. 38,46	12. 29,09	15,75	15,02	4,90
8	3.	44.	31	3.	46.	46	3. 18,86	11. 57,89	16,55	15,80	5,02
9	4.	2.	31	4.	4.	46	3. 53,64	11. 23,01	17,38	16,56	5,30
10	4.	3.	41	4.	5.	56	3. 55,6	11. 21,05	17,45	16,62	5,31
11	4.	8.	39	4.	10.	54	4. 8,54	11. 8,11	17,63	16,64	5,32
12	4.	10.	9	4.	12.	24	4. 13,85	11. 2,8	17,66	16,80	5,35
13	4.	14.	53	4.	17.	8	4. 15,81	11. 0,84	17,83	17,01	5,44
14	4.	22.	5	4.	24.	20	4. 22,10	10. 53,55	18,10	17,20	5,52
15	4.	25.	37	4.	27.	52	4. 30,36	10. 46,29	18,20	17,30	5,56
16	4.	29.	47	4.	32.	2	4. 35,92	10. 40,73	18,40	17,50	5,68
17	4.	41.	57	4.	44.	12	4. 50,14	10. 26,51	18,80	17,90	5,90
18	4.	44.	0	4.	46.	15	4. 51,96	10. 24,69	18,94	17,98	5,97
19	4.	51.	18	4.	53.	33	4. 58,62	10. 18,03	19,14	18,10	6,06
20	4.	52.	16	4.	54.	31	5. 1,23	10. 15,42	19,16	18,16	6,09
21	4.	53.	27	4.	55.	42	5. 1,23	10. 15,42	19,20	18,20	6,12
22	4.	54.	52	4.	57.	7	5. 3,18	10. 13,47	19,26	18,26	6,17
23	4.	56.	30	4.	58.	45	5. 5,14	10. 11,51	19,30	18,30	6,20
24	4.	58.	29	5.	0.	44	5. 6,44	10. 10,21	19,36	18,35	6,24
25	5.	1.	35	5.	3.	50	5. 5,14	10. 11,51	19,44	18,43	6,30
26	5.	9.	29	5.	11.	44	5. 5,79	10. 10,86	19,55	18,52	6,46
27	5.	11.	52	5.	14.	7	5. 9,05	10. 7,6	19,68	18,74	6,50
28	5.	18.	29	5.	20.	44	5. 12,96	10. 3,64	19,95	18,85	6,69
29	5.	20.	29	5.	22.	43	5. 14,26	10. 2,39	20,05	18,90	6,76
30	5.	24.	17	4.	26.	31	5. 14,26	10. 2,39	20,14	18,98	6,90
31	5.	25.	59	5.	28.	13	5. 9,7	10. 6,95	20,19	18,99	6,91
32	5.	28.	33	5.	30.	47	5. 8,4	10. 8,25	20,20	19,01	6,96
33	5.	33.	39	5.	35.	53	5. 5,14	10. 11,51	20,36	19,08	7,08
34	5.	35.	45	5.	37.	59	5. 1,88	10. 14,77	20,40	19,10	7,10
35	5.	43.	17	5.	45.	31	5. 2,53	10. 14,12	20,50	19,18	7,28
36	6.	1.	13	6.	3.	27	4. 50,79	10. 26,86	20,84	19,34	7,78
37	6.	2.	39	6.	4.	53	4. 49,49	10. 27,16	20,90	19,38	7,88
38	6.	8.	7	6.	10.	21	4. 44,27	10. 32,38	20,96	19,42	7,97
39	6.	10.	4	6.	12.	18	4. 43,52	10. 33,13	21,0	19,44	8,00
40	6.	18.	37	6.	20.	51	4. 30,58	10. 46,07	21,04	19,46	8,20
41	6.	21.	49	6.	24.	3	4. 24,06	10. 52,59	21,10	19,48	8,32
42	6.	26.	13	6.	28.	27	4. 15,81	11. 0,84	21,14	19,50	8,40

No. of Obser.	M. Time.			Ap. Time.			Nearest	Nearest	Par. of	Par. of	Par. of ♀
							dist. of the	distance of	♀ in	♀ in	perpen-
							limbs of ☉	their cen-	the	her	dic. to
							and ♀	ters.	Ver-	Path.	her Path
	h.	m.	sec.	h.	m.	sec.	m. sec.	m. sec.	tical.	sec.	sec.
43	6.	32.	18	6.	34.	32	4. 1,46	11. 14,19	21,18	19,50	8,60
44	6.	33.	55	6.	36.	9	4. 3,42	11. 13,23	21,20	19,46	8,68
45	6.	37.	29	6.	39.	43	3. 58,2	11. 18,45	21,22	19,43	8,76
46	6.	38.	55	6.	41.	9	3. 54,29	11. 22,36	21,24	19,40	8,82
47	6.	41.	39	6.	43.	53	3. 49,73	11. 26,92	21,26	19,36	8,92
48	6.	43.	57	6.	46.	11	3. 44,94	11. 31,71	21,28	19,34	8,98
49	6.	46.	25	6.	48.	39	3. 42,98	11. 33,67	21,29	19,31	9,02
50	6.	48.	49	6.	51.	3	3. 36,46	11. 39,19	21,30	19,29	9,17
51	6.	53.	17	6.	55.	31	3. 28,64	11. 48,01	21,34	19,26	9,21
52	7.	2.	17	7.	4.	15	3. 9,08	12. 7,57	21,38	19,24	9,48
53	7.	4.	33	7.	6.	47	3. 4,52	12. 12,13	21,39	19,20	9,56
54	7.	9.	26	7.	11.	40	3. 5,82	12. 11,83	21,40	19,10	9,70

THE foregoing nearest distances of their centers are deduced from the measured distances of their limbs, taking their diameters as they are stated above: And the parallaxes are not computed, but measured from a projection of the disc of the earth as seen from the Sun, the projection being 21 inches and an half in diameter.

THE latitude of our Observatory in Philadelphia is determined from the Observations of Messrs. Mason and Dixon with the above mentioned Sector. From a mean of thirty Observations of the passage of some stars over the Meridian, they found the latitude of the most southern point of the city of Philadelphia to be $39^{\circ}.56'.29''$. Our Observatory is North of this point, 25 seconds, and therefore its latitude is $39^{\circ}.56'.54''$.

In order to determine the parallax of the Sun, from the foregoing Observations, it is necessary that our longitude from some fixed Meridian should be ascertained with the most rigorous precision. For this purpose we have observed various Eclipses of Jupiter's Satellites, that they might be compared with the correspondent Observations made at Greenwich and elsewhere, when we are furnished with them.

Eclipses

Eclipses of JUPITER'S SATELLITES, observed at Philadelphia, with
a Two Feet Reflector.

D. h. m. sec.	D. h. m. sec.
1767. April 3, 7. 11. 23 Em. 2d. Ap. T.	1769. April 3, 14. 50. 48 Im. 1st. Ap. T.
May 30, 10. 15. 32 Em. 1st.	11, 9. 49. 14 Im. 2d.
June 13, 9. 18. 6 Em. 2d.	12, 11. 15. 49 Im. 1st.
1768. Mar. 1, 9. 46. 49 Im. 1st.	May 5, 11. 30. 28 Im. 1st.
April 9, 10. 37. 2 Em. 1st.	With a four feet Reflector.
25, 8. 56. 50 Em. 1st.	June 7, 8. 44. 37 Em. 2d.
May 12, 10. 33. 9 Em. 2d.	22, 8. 27. 35 Em. 1st.
1769. Feb. 16, 14. 21. 51 Im. 1st.	29, 10. 21. 55 Em. 1st.
20, 15. 42. 1 Im. 2d.	Aug. 23, 12. 15. 48 Em. 1st.
23, 16. 16. 21 Im. 1st.	Sept. 11, 7. 44. 41 Em. 2d.
Mar. 17, 12. 45. 21 Im. 2d.	

SINCE the foregoing account has been drawn up, we have been furnished with some Observations of the eclipses of Jupiter's satellites, made by the Revd. Mr. Maskelyne, Astronomer Royal, at Greenwich. By comparing these with the like Observations made at Philadelphia and Norriton, we are enabled to settle the longitudes of our Observatories. But as there are but two or three of them correspondent with ours, we must have recourse to another method; which is first to compare them with the calculations in the Nautical Almanac, which were made for the meridian of Greenwich, that the error of the tables may be discovered by the mean of them; and then to compare ours with the same calculations, applying the errors of the tables to the longitude deduced from this comparison. We may depend upon the result of this method with much more confidence, than upon any single observation.

Here follow the Apparent Times of the Greenwich Observations compared with the calculations of the Nautical Almanac.

1769. D. h. m. sec.	1769. D. h. m. sec.
Mar. 29, 12. 25. 7 Im. 1st. Obs. at Gr.	April 28, 14. 35. 17 Im. 1st. Obs. at Gr.
29, 12. 24. 26 Do. p. calc. of N. Al.	28, 14. 36. 14 Do. p. calc. of N. Al.
41 Error West.	57 Error East.
Apr. 11, 14. 50. 23 Im. 2d. Obs. at Gr.	May 6, 11. 51. 2 Im. 2d. Obs. at Gr.
11, 14. 50. 4 Do. p. calc. of N. Al.	6, 11. 51. 45 Do. p. calc. of N. Al.
19 Error West.	43 Error East.
12, 16. 16. 13 Im. 1st. Obs. at Gr.	May 16, 9. 31. 15 Em. 1st. Obs. at Gr.
12, 16. 16. 13 Do. p. calc. of N. Al.	16, 9. 31. 7 D. p. calc. of N. Al.
00	1. 8 Error West.

1769. D. h. m. sec.	1769. D. h. m. sec.
June 8, 9. 41. 16 Em. 1st. Obs. at Gr.	July 1, 9. 50. 24 Em. 1st. Obs. at Gr.
8, 9. 41. 26 Do. p. calc. of N. Al.	1, 9. 50. 37 Do. p. calc. of N. Al.
10 Error East.	13 Error East.
15, 11. 35. 33 Em. 1st. Obs. at Gr.	
15, 11. 34. 55 Do. p. calc. of N. Al.	
38 Error West.	

Now altho' the errors of the first satellite appear considerable, yet if we reject the Observation of the 16th of May as being too near to the time of Jupiter's opposition with the Sun; the mean of those, which give an eastern meridian corresponding with the calculations of the Nautical Almanac, exactly counterbalances the mean of those which give a western meridian corresponding with them. Therefore we have nothing to do but to reduce all our Observations at Norriton and Philadelphia to the meridian of Philadelphia, and then compare them with the calculations in the Nautical Almanac.

The Norriton Observations of the eclipses of Jupiter's first Satellite are as follow.

D. h. m. sec.	1769. D. h. m. sec.
1769. Feb. 16, 14. 21. 10 Im. 1st.	May 14, 10. 2. 14 Em. 1st. doubtful.
23, 16. 15. 1 Im. 1st.	21, 11. 55. 13 Em. 1st.
April 3, 14. 49. 25 Im. 1st.	June 6, 10. 11. 32 Em. 1st.
10, 16. 46. 0 Im. 1st.	7, 8. 43. 44 Em. 2d.
12, 11. 14. 37 Im. 1st.	13, 12. 5. 1 Em. 1st.
May 5, 11. 29. 27 Im. 1st.	

Now if we compare the correspondent Observations at Philadelphia and Norriton on the 16th of February, the 12th of April, the 5th of May, and the 7th of June 1769, the difference of our meridians will be found from the mean of them to be 57 seconds of time. This is farther confirmed by the Observations we have made on the Transit of Mercury over the Sun, on the 9th of November, 1769, which being completed before these sheets were printed off, we have judged proper to insert.

Apparent Time. h. m. sec.	
The exte. contact was at 2. 36. 9 by the mean of 4 Obser. at Philadelphia,	
And at 2. 35. 17 by the mean of 3 Obser. at Norriton.	
The difference is, 52	
The inter. contact was at 2. 37. 34 by the mean of 4 Obser. at Philadelphia,	
And at 2. 36. 34 by the mean of 3 Obser. at Norriton.	
The difference is 1. 0	

THEREFORE

THEREFORE the mean of both these makes the difference of our meridians 56 seconds of time, which must certainly be more accurate than what is deduced from a few corresponding Observations of the eclipses of Jupiter's satellites; both because they afford 24 comparisons, all nearly agreeing among themselves, and because these Transits, in the judgment of most astronomers, afford the best opportunities of settling the longitudes of places. Hence if we add 56 seconds to the time of the Norriton Observations of the eclipses of Jupiter's satellites, they will be reduced to the meridian of our Observatory in Philadelphia, and may be used in fixing our longitude from Greenwich, in the following manner.

The calculated Time per Nautical Almanac.	The observed Time at Philad.	The Norriton Obs. red. to the Mer. of Phil.	The Diff. of Mer. of Gr. and Phil.
D. h. m. sec.	D. h. m. sec.	D. h. m. sec.	D. h. sec.
1767. May 30, 15. 16. 10 Em. 1st.	30, 10. 15. 32	- - - -	5. 0. 38
June 13, 14. 17. 37 Em. 2d.	13, 9. 18. 6	- - - -	4. 59. 31
1768. Mar. 1, 14. 48. 24 Im. 1st.	1, 9. 46. 49	- - - -	5. 1. 35
April 9, 15. 36. 34 Em. 1st.	9, 10. 37. 2	- - - -	4. 59. 32
25, 13. 57. 46 Em. 1st.	25, 8. 56. 50	- - - -	5. 0. 56
May 12, 15. 34. 11 Em. 2d.	12, 10. 33. 9	- - - -	5. 1. 2
1769. Feb. 16, 19. 22. 29 Im. 1st.	16, 14. 21. 51	- - - -	5. 0. 38
16, 19. 22. 29 Im. 1st.	- - - -	16, 14. 22. 6	5. 0. 23
20, 20. 42. 55 Im. 2d.	20, 15. 42. 1	- - - -	5. 0. 54
23, 21. 16. 35 Im. 1st.	23, 16. 16. 21	- - - -	5. 0. 14
23, 21. 16. 35 Im. 1st.	- - - -	23, 16. 15. 57	5. 0. 38
Mar. 17, 17. 46. 4 Im. 2d.	17, 12. 45. 21	- - - -	5. 0. 43
April 3, 19. 51. 24 Im. 1st.	3, 14. 50. 48	- - - -	5. 0. 36
3, 19. 51. 24 Im. 1st.	- - - -	3, 14. 50. 21	5. 1. 3
10, 21. 47. 14 Im. 1st.	- - - -	10, 16. 46. 56	5. 0. 18
11, 14. 50. 4 Im. 2d.	11, 9. 49. 14	- - - -	5. 0. 50
12, 16. 16. 13 Im. 1st.	12, 11. 15. 49	- - - -	5. 0. 24
12, 16. 16. 13 Im. 1st.	- - - -	12, 11. 15. 33	5. 0. 40
May 5, 16. 31. 20 Im. 1st.	5, 11. 30. 28	- - - -	5. 0. 52
5, 16. 31. 20 Im. 1st.	- - - -	5, 11. 30. 23	5. 0. 57
21, 16. 56. 49 Em. 1st.	- - - -	21, 11. 56. 9	5. 0. 40
June 6, 15. 12. 59 Em. 1st.	- - - -	6, 10. 12. 28	5. 0. 31
7, 13. 45. 13 Em. 2d.	7, 8. 44. 37	- - - -	5. 0. 36
7, 13. 45. 13 Em. 2d.	- - - -	7, 8. 44. 39	5. 0. 34
13, 17. 6. 31 Em. 1st.	- - - -	13, 12. 5. 57	5. 0. 34
22, 13. 28. 30 Em. 1st.	22, 8. 27. 35	- - - -	5. 0. 55
29, 15. 22. 11 Em. 1st.	29, 10. 21. 55	- - - -	5. 0. 16
Aug. 23, 12. 15. 49 Em. 1st.	23, 7. 15. 48	- - - -	5. 0. 1
Sept. 11, 12. 45. 10 Em. 2d.	11, 7. 44. 41	- - - -	5. 0. 29

Now

Now if we take the mean of all the 21 foregoing determinations of our longitude from Greenwich, by the eclipses of the first satellite, rejecting only those of March 1st, and April 9th, 1768, which differ most from the others, the result will be $5^h. 0'. 35''$ for the difference of our meridians. These ought evidently to be rejected, as they differ near twice as much, from the mean of the rest, as any other of the determinations do, yet the retaining of them will make no difference in the result. If the mean determination of the longitude be taken from the immersions alone, rejecting that of the 1st of March, 1768, it will be $5^h. 0'. 36''$, and if from the emersions alone, it will be $5^h. 0'. 34''$, when the Observation of the 9th of April, 1768, is excluded. Therefore the mean of both, (which should always be preferred,) is $5^h. 0'. 35''$.

As a farther confirmation of this conclusion; if this difference of meridians be applied to the Greenwich Observations, of the first satellite, rejecting that of the 16th of May, to reduce them to the meridian of Philadelphia, and if they are then compared with the calculations in the Nautical Almanac; we shall have the same result from them also.

The calculated Time per Nautical Almanac.				Greenwich Obs. reduced to the Merid. of Philadelphia.				Diff. of Meridian of Greenwich and Philadelphia.			
1769. D.	h.	m.	sec.	D.	h.	m.	sec.	h.	m.	sec.	
Mar. 29,	12.	24.	26 Im. 1st.	29,	7.	24.	32	4.	59.	54	
April 12,	16.	16.	13 Im. 1st.	12,	11.	15.	38	5.	0.	35	
28,	14.	36.	14 Im. 1st.	28,	9.	34.	42	5.	1.	32	
June 8,	9.	41.	26 Em. 1st.	8,	4.	40.	41	5.	0.	5	
15,	11.	34.	55 Em. 1st.	15,	6.	34.	58	4.	59.	57	
July 1,	9.	50.	37 Em. 1st.	1,	4.	49.	49	5.	0.	48	
April 11,	14.	50.	4 Im. 2d.	11,	9.	49.	48	5.	0.	16	
May 6,	11.	51.	45 Im. 2d.	6,	6.	50.	27	5.	1.	18	

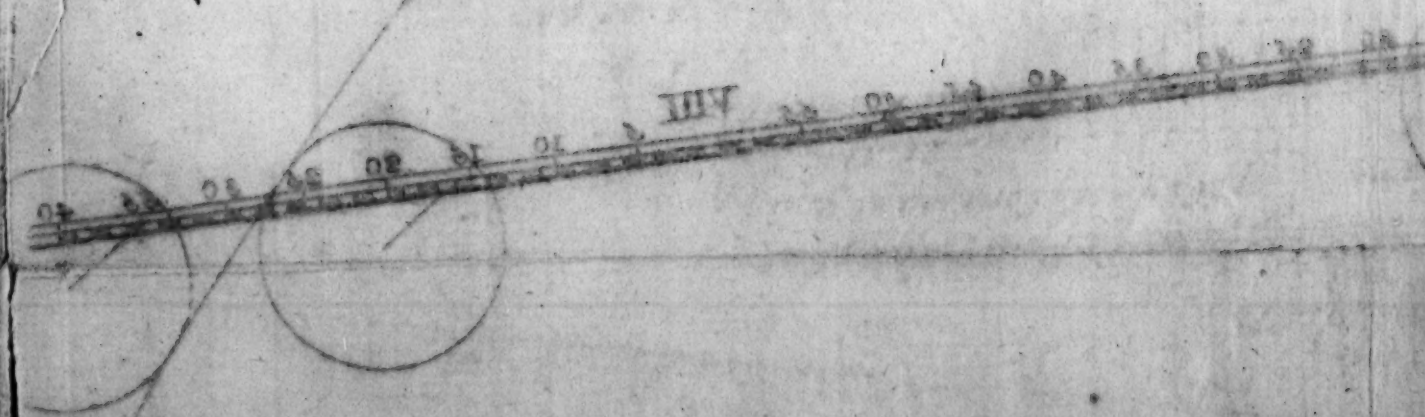
THE mean of these determinations of the longitude, from the Greenwich Observations of the first satellite, is $5^h. 0'. 35''$. But farther if we take the mean of all the determinations, derived from the eclipses of the second satellite, it will be found to be $5^h. 0'. 37''$. And lastly, if the mean of all the determinations from the eclipses of both first and second satellite be chosen, the

1714

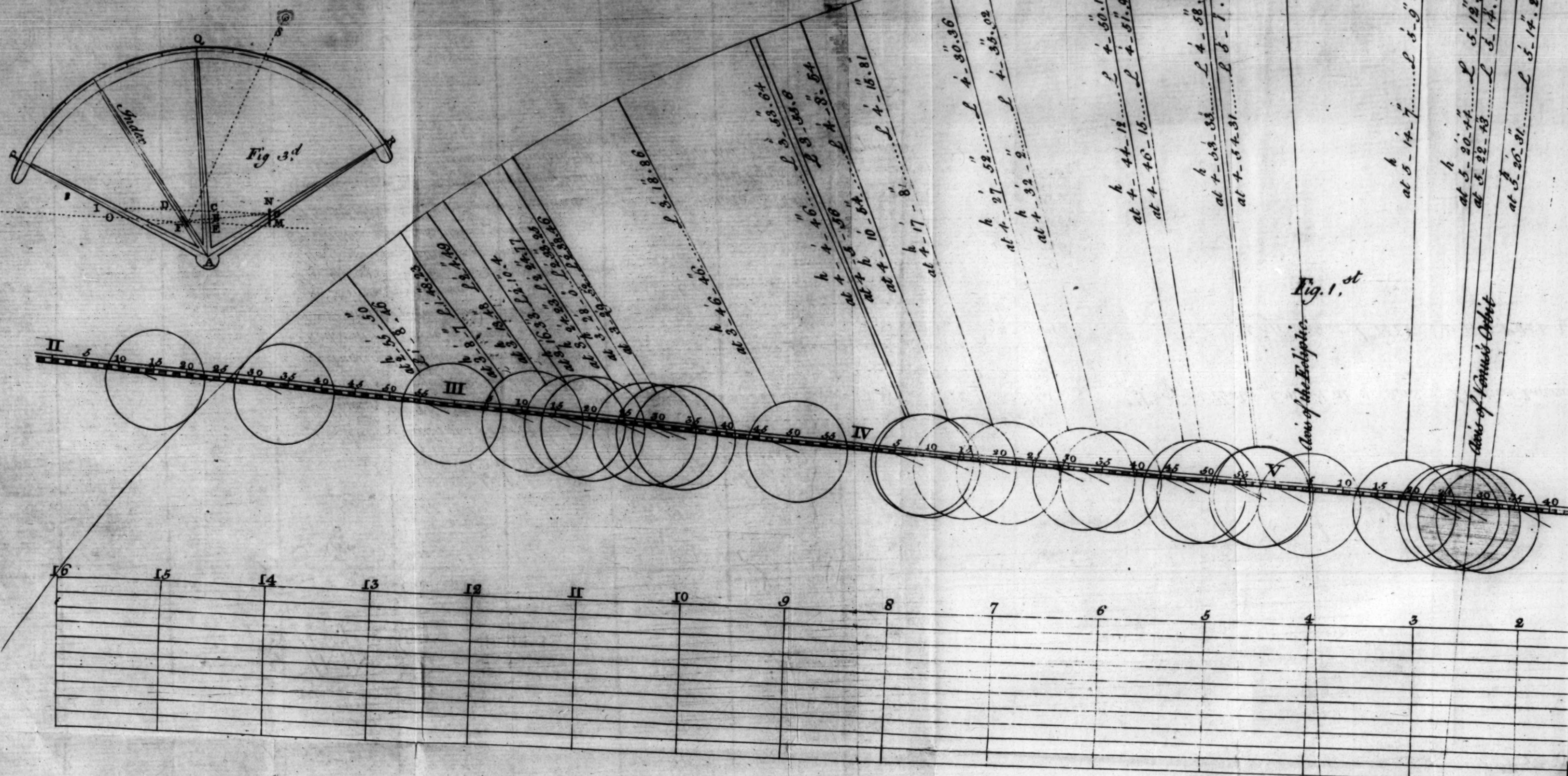
James G. Wood



A tilted table with multiple columns of numbers. The numbers are arranged in rows and columns, following the tilt of the table. The numbers are small and difficult to read, but they appear to be numerical data.



The Projection of the Transit of Venus



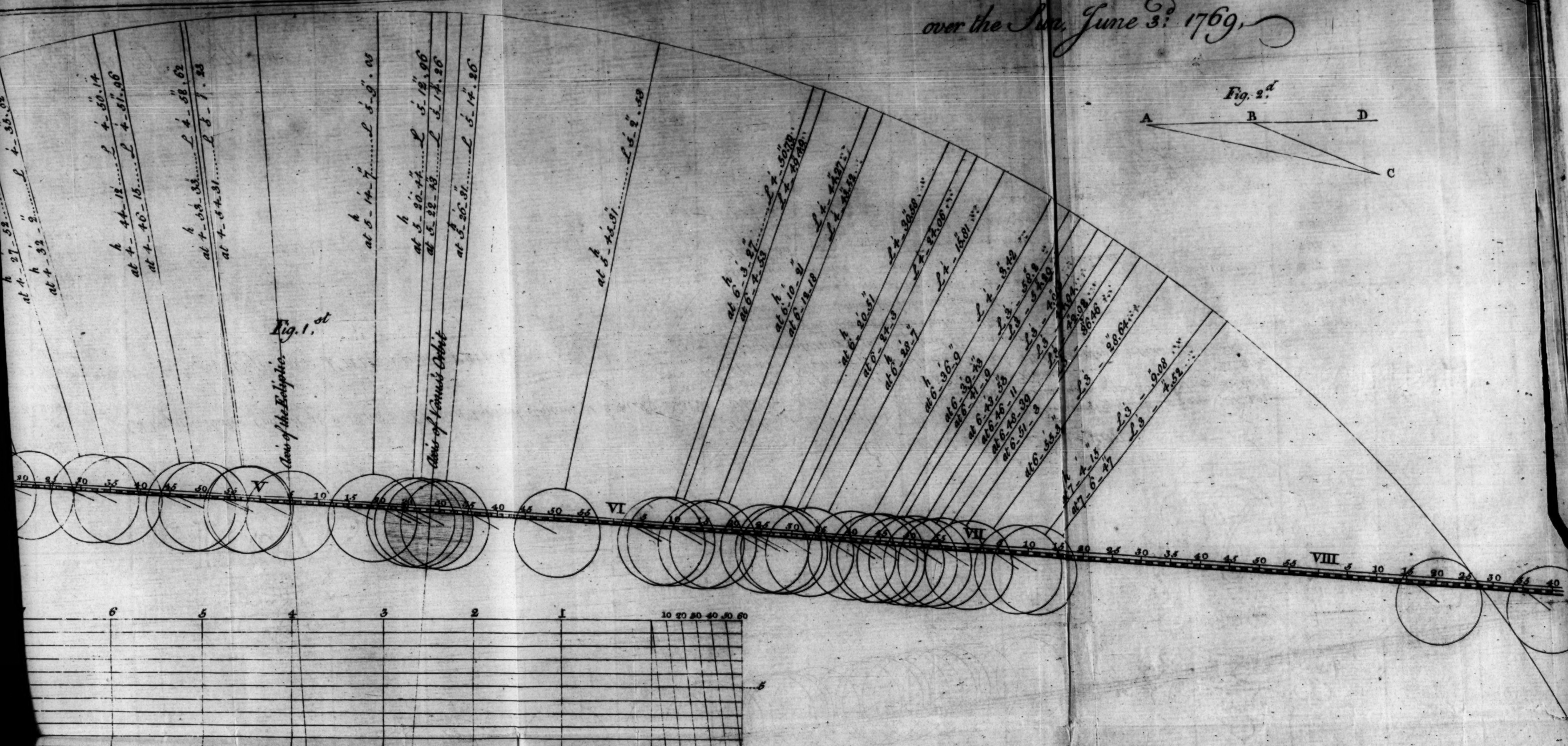
Elements of the Projection

The Place of the Sun and Venus at the Equinoctial Conjunction	2° 13' 27".7
The Place of the Ascending Node of Venus	2° 14' 35".389
The Sun's Distance from the Node of Venus	1° 8' 20".2
The Angle of her visible Path with the Equinox	8° 33' 11".5
The horary Motion of Venus	3° 57' 17".65
The Diameter of the Sun on the Day of the Transit	31' 31".3
The Diameter of Venus	58"
The Geocentric nearest Distance of their Centers	10° 10' 49"
The Geocentric Latitude of Venus	10° 17' 33".6
The Heliocentric Latitude of Venus	4° 5' 48".5
The Hor. Parallax of the Sun, at his mean Distance 113,100,000 Eq. Parts	8".684
For the Day of the Transit when his Distance was 101,506,894 Parts	8".555
The Sun's mean Distance in English Miles according to that Parallax 94,790,550	

The first Exter. Contact, at 2° 13' 48" The first Inter.

Observed at PHILADELPHIA

over the Sea, June 3^d 1769,



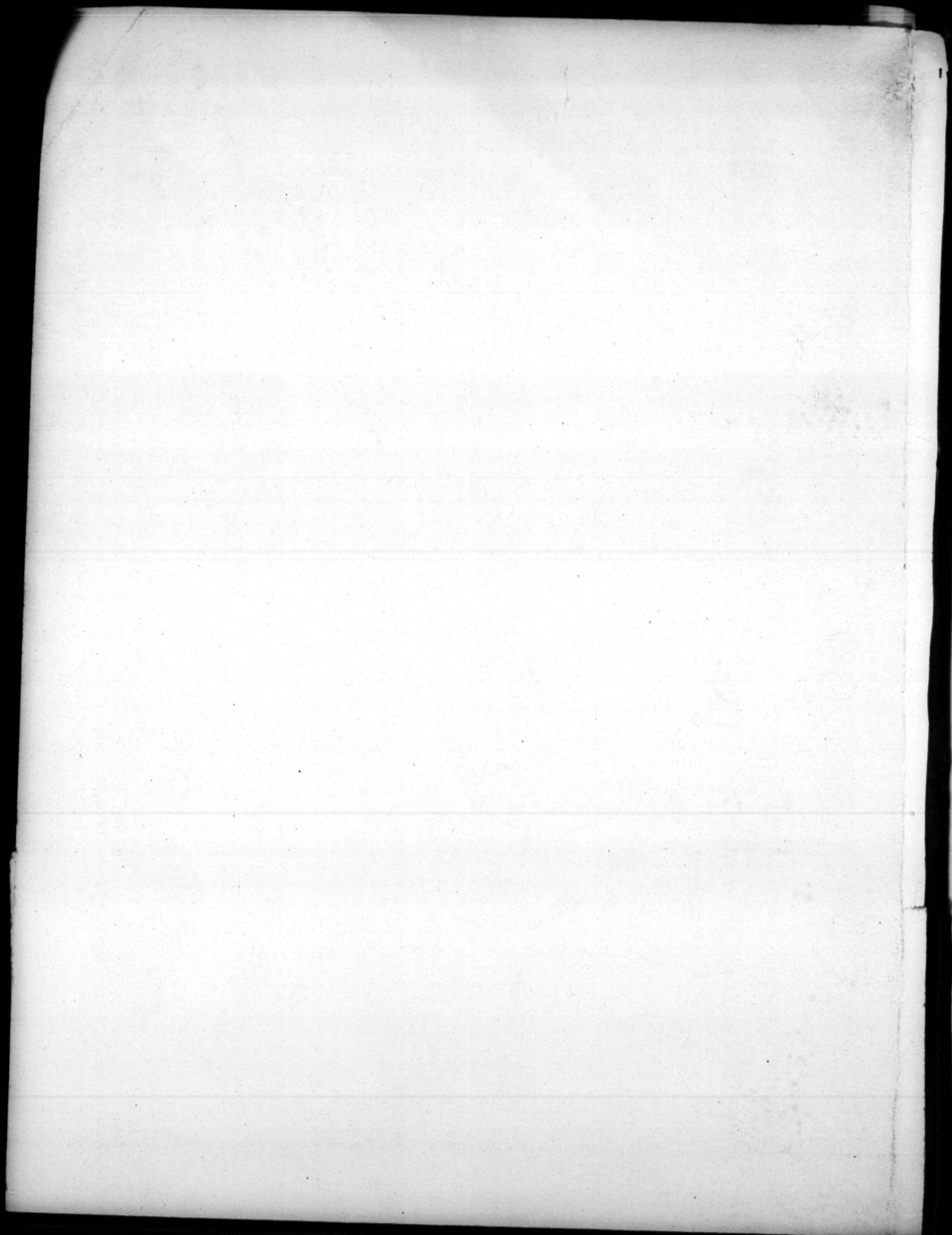
The first Exter. Contact, at 2^h 13^m 48^s. The first Internal Contact at 2^h 31^m 26^s Ap. T.

Observed at PHILADELPHIA.

Elements of the Projection

The Horizontal Parallax of Venus at her mean Distance 13,72333 Eq. Parts.	31.38685
The Day of the Transit when her Disk from the Sun was	72626.45 Eq. Parts. 30.069
Her Hor. Par. from the Sun on the Day of the Transit	21.314
Her mean Distance from the Sun in English Miles according to that Parallax	68564850
The apparent Time of the Elliptical Conjunction	5 ^h 5 ^m 16 ^s
The middle of the Transit at the Center of the Earth	5 ^h 28 ^m 29 ^s 1/4
The Intersection between the internal Contacts	2 ^h 59 ^m 38 ^s 7/8
The Transit begins as seen at the Earth's Center at	2 ^h 16 ^m 18 ^s
And being accelerated by Parallax 3 ^m 36 ^s of Time it begins at Philad. ^a at	2 ^h 12 ^m 42 ^s
The Total Ingress as seen at the Earth's Center at	2 ^h 35 ^m 31 ^s
And being accelerated by Parallax 4 ^m 4 ^s of Time it happens at	2 ^h 31 ^m 27 ^s
Projected for Lat. 39 [°] 36' 54" and Longitude West of Greenwich 75 [°] 3' 45" = 5 ^h 0 ^m 35 ^s of Time.	

by John Ewing.



the deduced longitude will be $5^h. 0'. 35''$. So that we may safely conclude, that the difference of meridians between Philadelphia and Greenwich, is $5^h. 0'. 35''$. ; and that Norriton is $56''$ of time west of Philadelphia, and its longitude is $5^h. 1'. 31''$. west. With this determination we must be contented until farther observations are made, by which it may be confirmed, or rendered liable to exception.

THESE Observations are sufficient to determine every thing relative to the theory of Venus, and the parallaxes of the Sun and planets, as may be seen by the annexed projection of the Transit, and the following calculations. Altho' the parallax of the Sun may be obtained from the observed nearest distance of the centers of the Sun and Venus, yet this method cannot be so much depended on, as the comparison of the contacts of the limbs observed in proper places, where the absolute difference of time is considerable. Nevertheless, as the public seem very impatient to know the result of what was done in this place ; I have endeavoured to deduce it from our Observations alone ; and flatter myself, that, in the conclusion, it will be found pretty accurate ; as it is nearly the same, with what I had before found it to be, by an hundred and forty determinations of it, from the Observations of Astronomers on the Transit of 1761 ; and also from another method, the invention of the celebrated Mr. Stuart, of Glasgow ; both which I have now annexed to the following calculations.

HAVING thus collected together all the elements necessary for the ensuing calculation ; before I proceed to it, I must, in justice to Dr. Williamson and Mr. Prior, observe, that of the Micrometer measures, the 2d, 3d, 19th, 20th, 21st, 22d, 23d, 24th, and 25th were made by Mr. Prior, and the 35th, 43d, 44th, and 54th by Dr. Williamson, with the same adjustment of the focus, that I used in the others.

I HAVE taken the trouble of making above fifty determinations of the middle of the Transit, and find from a mean of them, that the nearest approach of their centers was at $5^h. 21'. 27''$ mean time, or $5^h. 23'. 41''. 7$ apparent time, which was

was hastened by parallax $4'.48''$ at Philadelphia; and therefore, that the central apparent time of the middle of the Transit was $5^h.28'.29''.7$, according to our meridian.

By comparing together eighteen determinations of the nearest distance of the center of the Sun and Venus, I find the mean of them to be $10'.3''.58$, as seen in Philadelphia. But she was then depressed $6''.91$ by parallax; and therefore, the geocent. nearest distance of the centers was $10'.10''.49 = 610''.49$. Therefore say,

As 72626.45 the dist. of $\odot$ from $\odot$: 28879.55 her dist. from $\odot$:: $610''.49$: helioc. dist. of their centers.

$$\begin{array}{r} 4. 861,0949 \\ 4. 460,5934 \\ 2. 785,6785 \\ \hline 7. 246,2689 \\ 2. 385,1740 = 242''.7583 = 4'.2'',7583 \text{ the helioc. dist. of their cent.} \end{array}$$

As $S, 3^\circ.23'.20''$ the incl. of $\odot$ orbit to the eclip. : $R :: S, 4'.2'',7583$: Sine of $\odot$'s dist. from the node of $\odot$.

$$\begin{array}{r} 8. 771,6803 \\ 10. - - - \\ 7. 070,2506 \\ \hline 8. 298,5703 = 1^\circ.8'.20'',23 \odot \text{ dist. from the node of } \odot \end{array}$$

As $S, 1^\circ.8'.20'',23$: $R :: S, 10'.10'',49$: S , of the angle of her visible path with the eclip.

$$\begin{array}{r} 8. 298,5703 \\ 10. - - - \\ 7. 470,9623 \\ \hline 9. 172,3920 = 8^\circ.33'.11'',5 \text{ the angle of her visible path.} \end{array}$$

If AB represent the horary motion of $\odot = 2',392375$. See Pl. IV. Fig. 2d. BAC the inclination of the orbit of $\odot$ with the ecliptic $= 3^\circ.23'.20''$ DBC the angle of $\odot$ visi. path with the eclipt. $= 8^\circ.33'.11'',5$

Then AC will represent the horary motion of $\odot$ and may be found by the following proportion;

As $S, ACB : AB :: S, DBC$ or $ABC : AC$.

As $S, 5^\circ.9'.51'',5 : 2',3922357 :: S, 8^\circ.33'.11'',5$: the hor. mot. of $\odot$

$$\begin{array}{r} 8. 954,3008 \\ 0. 378,8292 \\ 9. 172,3920 \end{array}$$

$0.596,9204 = 3',952942 = 237'',17652$ the hor. mot. $\odot$ whose log. is $2.375,0716$.

the

916,65 = the diff. of the semidiameters of ☉ and ♀
610,49 = the geo. nearest dist. of their centers.

Sum, 1527,14 = 3. 183,8789
Diff. 306,16 = 2. 485,9484

5. 669,8273 the log. of the square of half the transit line between the internal contacts.

2. 834,9136 = the log. of half the transit line between the

2. 375,0716 = the log. of ♀ hor. mot. [int. cont. = 683",776

0. 459,8420 = 2h. 882982 = 2h. 52'. 58",7 = the semiduration between the int. contacts.

974,65 = the sum of the semidiameters of ☉ and ♀
610,49 = the geo. nearest dist. of their centers.

Sum, 1585,14 3. 200,0677
Diff. 364,16 2. 561,2922

5. 701,3599

2. 880,6799 = the log. of half the transit line between the

2. 375,0716 = the log. of ♀ hor. mot. [ext. co. = 759",766

0. 505,6083 = 3h. 20338 = 3h. 12'. 12",168 = the semiduration between the ext. contacts.

As R : Sec, 8°. 33'. 11",5 :: 610",49 : geo. latitude of ♀

10. - - -

10. 004,8572

2. 785,6785

2. 790,5357 = 617",356 = 10°. 17",336 = the geo. lat. of ♀

As 72626,45 : 28879,55 :: geo. lat. : hel. lat. of ♀

4. 861,0949

4. 460,5904

2. 790,5357

7. 251,1261

2. 390,0312 = 245",4885 = 4°. 5",4885 = the hel. lat. of ♀

610,49

617,356

1227,846 3. 089,1440

96,866 0. 836,7038

3. 925,8478

1. 962,9239

2. 375,0716 = the log. of hor. mot. of ♀

9. 587,8523 = 0h. 387126 = 23'. 13",6536 = the time between the middle and eclip. conjunction.

I

FROM

From the apparent time of the middle of the Transit, viz. $5^h. 28'. 29'', 7$ deduct $23'. 13'', 65$, and the apparent time of the ecliptical conjunction will be $5^h. 5'. 16'', 05$, when the Sun's place given in the Nautical Almanac was $2^s. 13^{\circ}. 27'. 18'', 7$, making the difference of our meridian from Greenwich $5^h. 0'. 35''$, as found above. To his place in the ecliptic add his distance from the node of Venus, found above, viz. $1^{\circ}. 8'. 20'', 23$, and the sum gives the place of her ascending node, $2^s. 14^{\circ}. 35'. 38'', 9$.

From the middle of the Transit, as seen at the center of the earth, viz. $5^h. 28'. 29'', 7$ apparent time, deduct the semiduration between the internal contacts, viz. $2^h. 52'. 58'', 7$, and there remains $2^h. 35'. 31''$ the apparent time of the first internal contact, without parallax. This I observed at $2^h. 31'. 26''$ apparent time; the difference between these is the total effect of parallax in longitude and latitude, which is $4'. 5''$. But upon the supposition that the Sun's horizontal parallax, on the day of the Transit, was $8'', 5204$, the total effect of parallax should have been $4'. 4''$. Therefore say,

As $4'. 4'' = 244'' : 4'. 5'' = 245'' :: 8'', 5204 : 8'', 555 =$
the hor. par. of the Sun on June 3d, 1769. Then

As $100000 =$ his mean dist. from the earth : $101506 =$ his dist. on the day of the Transit, $:: 8'', 555 : 8'', 6838$ his horizontal parallax at his mean distance from the earth.

THIS is nearly the same, with what is deduced from the best of the Observations made on the Transit of 1761: And according to this parallax of the Sun, the mean distances of the planets from the Sun will be, as they are exhibited in the following table, taking a mean semidiameter of the earth 3985 English miles.

36693417	Mercury's	} Mean distance from the Sun, in English miles.
68564850	Venus's	
94790550	the Earth's	
144431400	Mars's	
493005300	Jupiter's	
904307200	Saturn's	

ON account of the difficulty of ascertaining the precise moment of the middle of the Transit, from the mensurations of the nearest distances of the limbs of the Sun and Venus, and the small difference of time between the contacts happening, at the center of the earth, and at any particular place on its surface; Astronomers have generally preferred the comparison of two Observations at proper places, where the effects of parallax will be contrary to each other, retarding the contacts at one place and accelerating them at the other, for the purpose of deducing the parallax and distance of the Sun from them. We have an opportunity of confirming the former conclusions, by comparing our Observations with those that have been made at the Royal Observatory at Greenwich, as they have lately come to hand. They differ indeed considerably among themselves, probably owing to the various methods, which the Observers took to judge of the contacts, the account of which is not yet arrived here; yet they give a mean parallax of the Sun nearly the same that we have deduced from our own Observations at Philadelphia. I have therefore inserted them in this account of the Transit, as they serve to shew that we have not lost our labour and expence on this occasion. The method I have used is first to reduce the Greenwich Observations of the contacts to the meridian of our Observatory in Philadelphia, by deducting from them the difference of longitude converted into time; and then to calculate the effect of parallax for both places at the apparent times of the contacts, upon the supposition of the Sun's horizontal parallax being $8''.5204$ on the day of the Transit. From this, the Sun's horizontal parallax is found either greater or less, as the calculated effect of parallax is greater or less, than what is observed.

THE parallax of Venus in longitude at Greenwich, at the time of the first external contact was $16''.9$, which hastened the contact there $4'.16''.5$, and her parallax in lat. at the same time was, $12''.97$, which depressed her on the disc of the Sun, lengthened her visible path, and accelerated the contact $2'.34''.5$, so that the total effect of her parallax was to hasten the contact $6'.51''$ of time. In like manner her parallax in longitude at the internal contact was $16''.6$, which hastened

I 2

it

it 4'. 12" of time; and her parallax in latitude being 13",42 at that time, for the same reason hastened the said contact 2'. 40"; and therefore the total effect of parallax to accelerate the internal contact at Greenwich is 6'. 52".

At Philadelphia her parallax in longitude being 10",74 at the external contact, hastened it 2'. 43"; and her parallax in latitude being 4",43, lengthened her visible path on the Sun, and hastened the contact 53" of time; whence its total effect was 3'. 36" of time. In like manner her parallax in longitude at the internal contact being 11",95 hastened it 3'. 1" of time, and her parallax in lat. being 4",49 lengthened the transit line, and hastened the contact 1'. 3"; and therefore the total effect of her parallax at that time to hasten the internal contact was 4'. 4".

Now as the total effect of parallax both at Greenwich and at Philadelphia conspired to hasten the contacts at both these places, with respect to the center of the earth, their difference is the whole effect they have on absolute time, viz. 3'. 15" at the external contact, and 2'. 48" at the internal contact.

THE contacts were observed at Greenw. at the apparent times mentioned in the following table, according to their meridian.

Exter. Contact.			Int. Contact.			
h.	m.	sec.	h.	m.	sec.	
7.	10.	54	7.	28.	47	by Hitchins.
7.	11.	11	-	-	-	Hirst.
7.	10.	37	7.	29.	28	Dun.
7.	11.	19	7.	29.	20	Dolland.
7.	11.	30	7.	29.	20	Nairne.
7.	10.	58	7.	29.	23	Maskelyne.

THESE times are reduced to the meridian of Philadelphia, by subtracting 5^h. 0'. 35" from them in the following manner.

Exter. Contact.			Int. Contact.			
h.	m.	sec.	h.	m.	sec.	
2.	10.	19	2.	28.	12	by Hitchins.
2.	10.	36	-	-	-	Hirst.
2.	10.	2	2.	28.	53	Dun.
2.	10.	44	2.	28.	45	Dolland.
2.	10.	55	2.	28.	45	Nairne.
2.	10.	23	2.	28.	48	Maskelyne.
M. of all is, 2. 10. 30			2. 28. 40,6			THE

THE mean of all the times of the external contacts at Philadelphia is $2^h. 13'. 46''.6$, and of the internal contacts $2^h. 31'. 28''$, as appears by pag. 51, and the difference between these means is the observed effect of parallax.

h.	m.	sec.	h.	m.	sec.
2.	13.	46,6	2.	31.	28
2.	10.	30	2.	28.	40,6

3. 16,6

2. 47,4 the observed effects of

parallax, at the ext. and int. contacts. Therefore say,

As $3'. 15'' = 195''$ the calculated effect of parallax at the external contact is to $3'. 16''.6 = 196''.6 ::$ So is the assumed horizontal parallax of the Sun on the day of the Transit $8''.5204 :$ to his true parallax on that day. And in like manner, as $2'. 48'' = 168'' : 2'. 47''.4 = 167''.4 :: 8''.5204 :$ the Sun's par. on that day.

2. 290,0346

2. 225,3093

2. 293,5835

2. 223,7555

0. 930,4600

0. 930,4600

3. 224,0435

3. 154,2155

0. 934,0089 = $8''.59031$ $\odot$ hor. par. 0. 928,9062 = $8''.48997$ $\odot$ hor. par.

2) 17'',08028

$8''.54014$ the mean hor. par. of $\odot$ on the day of the Transit.

As 100000 : 101506 :: $8''.54014$: the Sun's horizontal parallax at his mean distance from the earth.

5. 000,0000

5. 006,4917

0. 931,4650

0. 937,9567 = $8''.66875$ the Sun's hor. par. at his mean distance from the earth.

THE parallax of the Sun being fixed by the mean of such comparisons as these, it is an easy matter to ascertain not only the distances of the bodies, which compose the solar system, but also their real diameters; that of the earth being previously known from the actual mensuration of some degrees on its surface. For

As the rectangle of the parallax of the Sun, and his distance from the earth, is to the real diameter of the earth; so is the rectangle of the parallax and distance of any other planet from the Sun, to its real diameter.

As

As to my delineation of the Transit; I have taken the elements of the projection from our own Observations on the 3d of June, 1769. Plate 4, fig. 2.

THE nearest approach of the centers having been determined, from the mean of a great number of computations, and found to agree very nearly with the measures that were actually made at the middle of the Transit, it was accordingly set off on the diameter of the Sun, and thro' this point a chord was drawn at right angles to the said diameter for the central transit line. This was then divided carefully into hours and minutes, according to the horary motion of Venus, determined by the preceeding calculation, in such a manner, as that the exact moment of the middle of the Transit, at the earth's center, should fall on the point of intersection between the said diameter of the Sun and transit line; this moment of time having been previously determined, by the mean of a sufficient number of computations.

THE parallaxes of Venus, in longitude and latitude, as seen from Philadelphia, having been also adapted to the apparent times of the micrometer measures, on the supposition of the Sun's horizontal par. being $8''.5204$ on the day of the Transit, they were accordingly applied to the projection, by which the places of her center were determined for the said times. Round these, small circles were drawn, with the radius of 29 seconds, to represent the disc of Venus on the face of the Sun; and lines were drawn between the limbs, in the direction of their centers, of such a determined length, as the micrometer has given them. Many of the measures were taken from the farthest limb of the Sun, as well as from the nearest, to both limbs of Venus, and these measures were afterwards reduced to the nearest distance of the nearest limbs, as they are exhibited in the preceeding Table, using the diameters of the Sun and Venus, as they are stated above.

As a confirmation of the foregoing conclusions, I have subjoined the Observations of Astronomers, in different places, of the contacts and durations of the Transit of 1761, as they have sent them to the Royal Society, together with the longitudes and latitudes of the places of Observation, on which the following calculations depend.

OBSER-

OBSERVATIONS on the Transit of VENUS over the SUN,
June 6th, 1761, N. S. Appar. Time.

Nam. of Places	1st Ex. Con.	1st In. Cont.	2d In. Con.	2d Ex. Con.	Duration.
	h. m. sec.	h. m. sec.	h. m. sec.	h. m. sec.	h. m. sec.
Greenwich,	- - -	- - -	8.19. 0	8.37. 9	- - -
Shirburn castle,	- - -	- - -	8.15.12	8.33.17	- - -
Saville house,	- - -	- - -	8.18.22	- - -	- - -
Spittal square,	- - -	- - -	8.18.41	- - -	- - -
Chelsea,	- - -	- - -	8.18. 4	- - -	- - -
Leskard,	- - -	- - -	8. 0.21	- - -	- - -
Paris,	- - -	- - -	8.28.27	8.46.44	- - -
Bologna,	- - -	- - -	9. 4.57	9.23. 0 } to 7 }	- - -
Rome,	- - -	- - -	9. 9.36	- - -	- - -
Drontheim,	- - -	- - -	9. 1.49	- - -	- - -
Upsal,	3.20.45	3.37.43 } to 56 }	9.28. 6	9.46.13 } to 30 }	5.50. 5 } to 26 }
Stockholm,	3.21.37	3.39.23 to 20	9.30.10	- - -	5.50.41 to 47
Hernofand,	3.20.40	3.38.26 to 35	9.28.52	9.46.43	5.50.17 to 26
Calmar,	- - -	3.33. 1	9.23.40	- - -	5.50.39
Abo,	- - -	3.55.50	9.45.59	10. 4.42	5.50. 9
Tornea,	3.45.44 } to 51 }	4. 4. 0	9.54. 8 } to 22 }	10.1. 8 to 22	5.50. 9 to 21
Cajaneburg,	- - -	4.19. 5	10. 8.59	- - -	5.49.54
Tobolski,	- - -	7. 0.28	12.49.20	13. 7.39½	5.48.50
Cape G. Hope,	- - -	- - -	9.39.50	- - -	- - -
Rodrigues,	- - -	- - -	12.35.47	12.53.18	- - -
Calcutta,	- - -	8.20.58	14.11.34	14.27.38	5.50.36
Madrafs,	7.31.10	7.47.55	13.39.38	13.55.44	5.51.43
Tranquebar,	- - -	- - -	- - -	- - -	5.51.33
Great Mount,	- - -	- - -	- - -	- - -	5.51.20

N. of Places	Latitude	Longitude fr. Greenw.	N. of Places	Latitude	Longitude fr. Greenw.
		h. m. sec.			h. m. sec.
Greenwich,	51.28.37N	0. 0. 0	Hernofand,	60.38. 0N	1.11.28E.
Shirb. castle	51.39.22N	0. 4. 1 W.	Calmar,	56.40.30N	1. 5.39E.
Sav. house,	- - -	0. 3.31 E.	Abo,	60.27. 0N	1.28.33E.
Spit. square,	- - -	0. 0.16½ W.	Tornea,	65.50.50N	1.36.48E.
Chelsea,	- - -	0. 0.40 W.	Cajaneburg,	64.13.30N	1.51.50E.
Leskard,	50.26.55N	0.18.32 W.	Tobolski,	58.12.22N	4.32.52E.
Paris,	48.50.14N	0. 9.16 E.	C. G. Hope,	33.55.42 S	1.13.35E.
Bologna,	44.29.36N	0.45.21 E.	Rodrigues,	19.40.40 S	4.12.34E.
Rome,	41.53.54N	0.49.53 E.	Calcutta,	22.30. 0N	5.53.44E.
Drontheim,	63.26.10N	0.44. 3 E.	Madrafs,	13. 8. 0N	5.20.10E.
Upsal,	59.51.50N	1.10.26 E.	Tranquebar,	10.56. 0N	5.18. 8E.
Stockholm,	59.20.30N	1.12.26 E.	Gr. Mount,	- - -	- - -

The Parallax of the SUN, deduced from the 2d Internal Contact of the Limbs of the SUN and VENUS, in the Transit of 1761.

Cape of G. Hope, & Leskard.	Cape & Sherburne Castle.	Cape & Chelsea.
Parall.	Parrall.	Parrall.
h. m. sec.	h. m. sec.	h. m. sec.
9. 39. 50 Cape, 6. 8	9. 39. 50 6. 8	9. 39. 50 6. 8
1. 32. 7 Diff. Long.	1. 17. 36 Diff. Long.	1. 14. 15
3. 7. 43	8. 22. 14	8. 5. 34
8. 0. 21 Lesk. r. 4	8. 15. 12 Shurb. i. 12	8. 18. 4 Ch. i. 11
7. 22 7. 12	7. 2 7. 20	7. 30 7. 19
As 7.12: 7.22 :: 8".5 :	Sun's Par. 8".15	Sun's Par. 8".73
☉'s Par. 8".69		
Cape & Saville House	Cape & Spittal Square.	Cape & Greenwich
9. 39. 50 6. 8	9. 39. 50 6. 8	9. 39. 50 6. 8
1. 14. 5	1. 13. 51	1. 13. 35
8. 25. 45	8. 25. 59	8. 26. 15
8. 1. 22 Sav. i. 11	8. 18. 41 Sp. Sq. i. 11	8. 19. 0 Green. i. 11
7. 23 7. 19	7. 18 7. 19	7. 15 7. 19
Sun's Par. 8.57	Sun's Par. 8.47	Sun's Par. 8.42
Cape & Paris.	Cape & Drontheim.	Cape & Bologna.
9. 39. 50 6. 8	9. 39. 50 6. 8	9. 39. 50 6. 8
1. 4. 19	0. 29. 32	0. 28. 14
8. 35. 31	9. 10. 18	9. 11. 36
8. 28. 27 0. 54	9. 1. 49 2. 38	9. 4. 57 0. 29
7. 4 7. 2	8. 29 8. 46	6. 39 6. 37
Sun's Par. 8.54	Sun's Par. 8.23	Sun's Par. 8.54
Cape & Rome.	Cape & Calmar.	Cape & Upsal.
9. 39. 50 6. 8	9. 39. 50 6. 8	9. 39. 50 6. 8
0. 23. 42	0. 7. 56	0. 3. 9
9. 16. 8	9. 31. 54	9. 36. 41
9. 9. 36 0. 13	9. 23. 40 1. 59	9. 28. 6 2. 21
6. 32 6. 21	8. 14 8. 7	8. 35 8. 29
Sun's Par. 8.74	Sun's Par. 8.62	Sun's Par. 8.60
Cape & Hernofand.	Cape & Stockholm.	Cape & Abo.
9. 39. 50 6. 8	9. 39. 50 6. 8	9. 39. 50 6. 8
0. 2. 7	0. 1. 9	+0. 14. 58
9. 37. 43	9. 38. 41	9. 54. 48
9. 28. 52 2. 26	9. 30. 10 2. 18	9. 45. 59 2. 38
8. 51 8. 34	8. 31 8. 26	8. 49 8. 38
Sun's Par. 8.78	Sun's Par. 8.58	Sun's Par. 8.68
Cape & Tornea.	Cape & Cajaneburg.	Cape & Tobolski.
9. 39. 50 6. 8	9. 39. 50 6. 8	9. 39. 50 6. 8
+0. 3. 13	+0. 38. 15	3. 13. 17
0. 3. 3	10. 18. 5	12. 59. 7
9. 54. 8 3. 5	10. 8. 51 2. 59	12. 49. 20 3. 35
8. 55 9. 13	9. 6 9. 7	9. 9. 47 9. 43
Sun's Par. 8.22	Sun's Par. 8.49	Sun's Par. 8.64

Cape

<i>Cape & Madras.</i>			<i>Cape & Calcutta.</i>			<i>Cape & Rodrigues.</i>		
h. m. sec.		Parall.	h. m. sec.		Parall.	h. m. sec.		Parall.
9. 39. 50		6. 8	9. 39. 50		6. 8	9. 39. 50		6. 8
4. 6. 35			4. 40. 9			2. 58. 59		
13. 40. 25			4. 19. 59			12. 38. 49		
13. 39. 38	0. 36		4. 11. 34	2. 14		12. 35. 47	3. 7	
6. 47	0. 44		8. 25	8. 22		3. 2	3. 1	
Sun's Par. 8. 74			Sun's Par. 8. 55			Sun's Par. 8. 54		
<i>Rodrigues & Lefkard.</i>			<i>Rodrigues & Sberburn cast.</i>			<i>Rodrigues & Chelsea.</i>		
12. 35. 47	3. 7		12. 35. 47	3. 7		12. 35. 47	3. 7	
4. 31. 6			4. 16. 35			4. 13. 14		
8. 4. 41			8. 19. 12			8. 22. 33		
8. 0. 21	1. 4		8. 15. 12	1. 12		8. 18. 4	1. 11	
4. 20	4. 11		4. 0	4. 19		4. 29	4. 18	
Sun's Par. 8. 80			Sun's Par. 8. 00			Sun's Par. 8. 86		
<i>Rodrigues & Saville bou.</i>			<i>Rodrigues & Spital square.</i>			<i>Rodrigues & Greenwich.</i>		
12. 35. 47	3. 7		12. 35. 47	3. 7		12. 35. 47	3. 7	
4. 13. 4			4. 12. 50			4. 12. 34		
8. 22. 43			8. 22. 57			8. 23. 13		
8. 18. 22	1. 11		8. 18. 41	1. 11		8. 19. 0	1. 11	
4. 21	4. 18		4. 16	4. 18		4. 13	4. 18	
Sun's Par. 8. 60			Sun's Par. 8. 44			Sun's Par. 8. 33		
<i>Rodrigues & Paris.</i>			<i>Rodrigues & Drontheim.</i>			<i>Rodrigues & Bologna.</i>		
12. 35. 47	3. 7		12. 35. 47	3. 7		12. 35. 47	3. 7	
4. 3. 18			3. 28. 31			3. 27. 13		
8. 32. 29			9. 7. 16			9. 8. 34		
8. 28. 27	0. 54		9. 1. 45	2. 38		9. 4. 57	0. 29	
4. 2	4. 1		5. 27	5. 45		3. 37	3. 36	
Sun's Par. 8. 53			Sun's Par. 8. 05			Sun's Par. 8. 54		
<i>Rodrigues & Rome.</i>			<i>Rodrigues & Calmar.</i>			<i>Rodrigues & Upsal.</i>		
12. 35. 47	3. 7		12. 35. 47	3. 7		12. 35. 47	3. 7	
3. 22. 41			3. 6. 55			3. 2. 8		
9. 13. 6			9. 28. 52			9. 33. 39		
9. 9. 36	0. 13		9. 23. 40	1. 59		9. 28. 6	2. 21	
3. 30	3. 20		5. 12	5. 6		5. 33	5. 28	
Sun's Par. 8. 92			Sun's Par. 8. 67			Sun's Par. 8. 62		
<i>Rodrigues & Hernofand.</i>			<i>Rodrigues & Stockholm.</i>			<i>Rodrigues & Abo.</i>		
12. 35. 47	3. 7		12. 35. 47	3. 7		12. 35. 47	3. 7	
3. 1. 6			3. 0. 8			2. 44. 1		
9. 34. 41			9. 35. 39			9. 51. 46		
9. 28. 52	2. 26		9. 30. 10	2. 18		9. 45. 59	2. 30	
5. 49	5. 33		5. 29	5. 25		5. 47	5. 37	
Sun's Par. 8. 90			Sun's Par. 8. 51			Sun's Par. 8. 75		

<i>Rodrigues & Tornea.</i>		<i>Rodrigues & Cajanaburg.</i>		<i>Rodrigues & Tobolski.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
12. 35. 47	3. 7	12. 35. 47	3. 7	12. 35. 47	3. 7
2. 35. 46		2. 20. 44		10. 20. 18	
10. 0. 1		10. 15. 3		12. 56. 5	
9. 54. 8	3. 5	10. 8. 59	2. 59	12. 49. 20	3. 35
5. 53	6. 12	6. 4	6. 6	6. 45	6. 42
Sun's Par. 8 ⁰⁰ . 07		Sun's Par. 8 ⁰⁰ . 45		Sun's Par. 8 ⁰⁰ . 56	
<i>Rodrigues & Calcutta.</i>		<i>Rodrigues & Madras.</i>		<i>Tobolski & Liskard.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
12. 35. 47	3. 7	12. 35. 47	3. 7	12. 49. 20	3. 35
1. 41. 10		1. 7. 36		4. 51. 24	
14. 16. 57		13. 43. 23		7. 57. 56	
14. 11. 34	2. 14	13. 39. 38	0. 36	8. 0. 21	1. 4
5. 23	5. 21	3. 45	3. 43	2. 25	2. 31
Sun's Par. 8. 55		Sun's Par. 8. 58		Sun's Par. 8. 16	
<i>Tobolski & Chelsea.</i>		<i>Tobolski & Saville house.</i>		<i>Tobolski & Spittal square.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
12. 49. 20	3. 35	12. 49. 20	3. 35	12. 49. 20	3. 35
4. 33. 32		4. 33. 22		4. 33. 9	
8. 15. 48		8. 15. 58		8. 16. 11	
8. 18. 4	1. 11	8. 18. 22	1. 12	8. 18. 41	1. 11
2. 16	2. 24	2. 34	2. 24	2. 30	2. 24
Sun's Par. 8. 02		Sun's Par. 8. 09		Sun's Par. 8. 85	
<i>Tobolski & Greenwich.</i>		<i>Tobolski & Paris.</i>		<i>Tobolski & Bologna.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
12. 49. 20	3. 35	12. 49. 20	3. 35	12. 49. 20	3. 35
4. 32. 52		4. 23. 36		3. 47. 31	
8. 16. 28		8. 25. 44		9. 1. 49	
8. 19. 0	1. 11	8. 28. 27	0. 54	9. 4. 57	0. 29
2. 32	2. 24	2. 43	2. 41	3. 8	3. 6
Sun's Par. 8. 97		Sun's Par. 8. 60		Sun's Par. 8. 59	
<i>Tobolski & Rome.</i>		<i>Tobolski & Calmar.</i>		<i>Tobolski & Upsal.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
12. 49. 20	3. 35	12. 49. 20	3. 35	12. 49. 20	3. 35
3. 42. 59		3. 27. 13		3. 22. 26	
9. 6. 21		9. 22. 7		9. 20. 54	
9. 9. 36	0. 13	9. 23. 40	1. 59	9. 28. 6	2. 21
3. 15	3. 22	1. 33	1. 36	1. 12	1. 14
Sun's Par. 8. 20		Sun's Par. 8. 23		Sun's Par. 8. 27	
<i>Tobolski & Stockholm.</i>		<i>Tobolski & Calcutta.</i>		<i>Tobolski & Madras.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
12. 49. 20	3. 35	12. 49. 20	3. 35	12. 49. 20	3. 35
3. 20. 26		1. 20. 52		0. 47. 18	
9. 28. 54		14. 10. 12		13. 36. 38	
9. 30. 10	2. 18	14. 11. 34	2. 14	13. 39. 38	0. 36
1. 16	1. 17	1. 22	1. 21	3. 0	2. 59
Sun's Par. 8. 39		Sun's Par. 8. 61		Sun's Par. 8. 55	

Cajanaburg.

<i>Cajaneburg & Sav. house.</i>			<i>Cajaneb. & Spittal square.</i>			<i>Cajaneburg & Greenwich.</i>		
Parall.			Parall.			Parall.		
h. m. sec.			h. m. sec.			h. m. sec.		
10. 8. 59	2. 59		10. 8. 59	2. 59		10. 8. 59	2. 59	
1. 52. 20			1. 52. 7			1. 51. 50		
8. 16. 39			8. 16. 52			8. 17. 9		
8. 18. 22	1. 11		8. 18. 41	1. 11		8. 19. 0	1. 11	
1. 43	1. 48		1. 49	1. 48		1. 51	1. 48	
Sun's Par. 8. 11			Sun's Par. 8. 58			Sun's Par. 8. 74		
<i>Cajaneburg & Paris.</i>			<i>Cajaneburg & Rome.</i>			<i>Cajaneburg & Bologna.</i>		
Parall.			Parall.			Parall.		
h. m. sec.			h. m. sec.			h. m. sec.		
10. 8. 59	2. 59		10. 8. 59	2. 59		10. 8. 59	2. 59	
1. 42. 34			1. 2. 7			1. 6. 29		
8. 26. 25			9. 6. 52			9. 2. 30		
8. 28. 27	0. 54		9. 9. 36	0. 13		9. 4. 57	0. 29	
2. 2	2. 5		2. 44	2. 46		2. 27	2. 30	
Sun's Par. 8. 30			Sun's Par. 8. 33			Sun's Par. 8. 33		
<i>Cajaneburg & Madras.</i>			<i>Stockholm & Spittal square.</i>			<i>Stockholm & Greenwich.</i>		
Parall.			Parall.			Parall.		
h. m. sec.			h. m. sec.			h. m. sec.		
10. 8. 59	2. 59		9. 30. 10	2. 18		9. 30. 10	2. 18	
3. 28. 20			1. 12. 43			1. 12. 20		
13. 37. 19			8. 17. 37			8. 17. 50		
13. 39. 38	0. 36		8. 18. 41	1. 11		8. 19. 0	1. 11	
2. 19	2. 23		1. 4	1. 7		1. 10	1. 7	
Sun's Par. 8. 27			Sun's Par. 8. 12			Sun's Par. 8. 88		
<i>Stockholm & Paris.</i>			<i>Stockholm & Bologna.</i>			<i>Stockholm & Rome.</i>		
Parall.			Parall.			Parall.		
h. m. sec.			h. m. sec.			h. m. sec.		
9. 30. 10	2. 18		9. 30. 10	2. 18		9. 30. 10	2. 18	
1. 3. 10			0. 27. 5			0. 22. 33		
8. 27. 0			9. 3. 5			9. 7. 37		
8. 28. 27	0. 54		9. 4. 57	0. 29		9. 9. 36	0. 13	
1. 27	1. 24		1. 52	1. 49		1. 59	2. 5	
Sun's Par. 8. 80			Sun's Par. 8. 73			Sun's Par. 8. 09		
<i>Stockholm & Madras.</i>			<i>Upsal & Leskard.</i>			<i>Upsal & Saville house.</i>		
Parall.			Parall.			Parall.		
h. m. sec.			h. m. sec.			h. m. sec.		
9. 30. 10	2. 18		9. 28. 6	2. 21		9. 28. 6	2. 21	
4. 7. 44			1. 28. 58			1. 10. 56		
13. 37. 54			7. 59. 8			8. 17. 10		
13. 39. 38	0. 36		8. 0. 21	1. 4		8. 18. 22	1. 11	
1. 44	1. 42		1. 13	1. 17		1. 12	1. 10	
Sun's Par. 8. 67			Sun's Par. 8. 06			Sun's Par. 8. 74		
<i>Upsal & Paris.</i>			<i>Upsal & Bologna.</i>			<i>Upsal & Rome.</i>		
Parall.			Parall.			Parall.		
h. m. sec.			h. m. sec.			h. m. sec.		
9. 28. 6	2. 21		9. 28. 6	2. 21		9. 28. 6	2. 21	
1. 1. 10			0. 25. 5			0. 20. 33		
8. 26. 56			9. 3. 1			9. 7. 33		
8. 28. 27	0. 54		9. 4. 57	0. 29		9. 9. 36	0. 13	
1. 31	1. 27		1. 56	1. 52		2. 3	2. 8	
Sun's Par. 8. 89			Sun's Par. 8. 0			Sun's Par. 8. 17		

<i>Rodrigues & Tornea.</i>		<i>Rodrigues & Cajaneburg.</i>		<i>Rodrigues & Tobolski.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
12. 35. 47	3. 7	12. 35. 47	3. 7	12. 35. 47	3. 7
2. 35. 46		2. 20. 44		10. 20. 18	
10. 0. 1		10. 15. 3		12. 56. 5	
9. 54. 8	3. 5	10. 8. 59	2. 59	12. 49. 20	3. 35
5. 53	6. 12	6. 4	6. 6	6. 45	6. 42
Sun's Par. 8.07		Sun's Par. 8.45		Sun's Par. 8.56	
<i>Rodrigues & Calcutta.</i>		<i>Rodrigues & Madras.</i>		<i>Tobolski & Leskard.</i>	
12. 35. 47	3. 7	12. 35. 47	3. 7	12. 49. 20	3. 35
1. 41. 10		1. 7. 36		4. 51. 24	
14. 16. 57		13. 43. 23		7. 57. 56	
14. 11. 34	2. 14	13. 39. 38	0. 36	8. 0. 21	1. 4
5. 23	5. 21	3. 45	3. 43	2. 25	2. 31
Sun's Par. 8.55		Sun's Par. 8.58		Sun's Par. 8.16	
<i>Tobolski & Chelsea.</i>		<i>Tobolski & Saville house.</i>		<i>Tobolski & Spittal square.</i>	
12. 49. 20	3. 35	12. 49. 20	3. 35	12. 49. 20	3. 35
4. 33. 32		4. 33. 22		4. 33. 9	
8. 15. 48		8. 15. 58		8. 16. 11	
8. 18. 4	1. 11	8. 18. 22	1. 12	8. 18. 41	1. 11
2. 16	2. 24	2. 34	2. 24	2. 30	2. 24
Sun's Par. 8.02		Sun's Par. 8.09		Sun's Par. 8.85	
<i>Tobolski & Greenwich.</i>		<i>Tobolski & Paris.</i>		<i>Tobolski & Bologna.</i>	
12. 49. 20	3. 35	12. 49. 20	3. 35	12. 49. 20	3. 35
4. 32. 52		4. 23. 36		3. 47. 31	
8. 16. 28		8. 25. 44		9. 1. 49	
8. 19. 0	1. 11	8. 28. 27	0. 54	9. 4. 57	0. 29
2. 32	2. 24	2. 43	2. 41	3. 8	3. 6
Sun's Par. 8.97		Sun's Par. 8.60		Sun's Par. 8.59	
<i>Tobolski & Rome.</i>		<i>Tobolski & Calmar.</i>		<i>Tobolski & Upsal.</i>	
12. 49. 20	3. 35	12. 49. 20	3. 35	12. 49. 20	3. 35
3. 42. 59		3. 27. 13		3. 22. 26	
9. 6. 21		9. 22. 7		9. 20. 54	
9. 9. 36	0. 13	9. 23. 40	1. 59	9. 28. 6	2. 21
3. 15	3. 22	1. 33	1. 36	1. 12	1. 14
Sun's Par. 8.20		Sun's Par. 8.23		Sun's Par. 8.27	
<i>Tobolski & Stockholm.</i>		<i>Tobolski & Calcutta.</i>		<i>Tobolski & Madras.</i>	
12. 49. 20	3. 35	12. 49. 20	3. 35	12. 49. 20	3. 35
3. 20. 26		1. 20. 52		0. 47. 18	
9. 28. 54		14. 10. 12		13. 36. 38	
9. 30. 10	2. 18	14. 11. 34	2. 14	13. 39. 38	0. 36
1. 16	1. 17	1. 22	1. 21	3. 0	2. 59
Sun's Par. 8.39		Sun's Par. 8.61		Sun's Par. 8.55	

Cajaneburg.

<i>Cajaneburg & Sav. house.</i>		<i>Cajaneb. & Spittal square.</i>		<i>Cajaneburg & Greenwich.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
10. 8. 59	2. 59	10. 8. 59	2. 59	10. 8. 59	2. 59
1. 52. 20		1. 52. 7		1. 51. 50	
8. 16. 39		8. 16. 52		8. 17. 9	
8. 18. 22	1. 11	8. 18. 41	1. 11	8. 19. 0	1. 11
1. 43	1. 48	1. 49	1. 48	1. 51	1. 48
Sun's Par. 8,11		Sun's Par. 8,58		Sun's Par. 8,74	
<i>Cajaneburg & Paris.</i>		<i>Cajaneburg & Rome.</i>		<i>Cajaneburg & Bologna.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
10. 8. 59	2. 59	10. 8. 59	2. 59	10. 8. 59	2. 59
1. 42. 34		1. 2. 7		1. 6. 29	
8. 26. 25		9. 6. 52		9. 2. 30	
8. 28. 27	0. 54	9. 9. 36	0. 13	9. 4. 57	0. 29
2. 2	2. 5	2. 44	2. 46	2. 27	2. 30
Sun's Par. 8,30		Sun's Par. 8,33		Sun's Par. 8,33	
<i>Cajaneburg & Madrajs.</i>		<i>Stockholm & Spittal square.</i>		<i>Stockholm & Greenwich.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
10. 8. 59	2. 59	9. 30. 10	2. 18	9. 30. 10	2. 18
3. 28. 20		1. 2. 43		1. 12. 20	
13. 37. 19		8. 17. 37		8. 17. 50	
13. 39. 38	0. 36	8. 18. 41	1. 11	8. 19. 0	1. 11
2. 19	2. 23	1. 4	1. 7	1. 10	1. 7
Sun's Par. 8,27		Sun's Par. 8,12		Sun's Par. 8,88	
<i>Stockholm & Paris.</i>		<i>Stockholm & Bologna.</i>		<i>Stockholm & Rome.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
9. 30. 10	2. 18	9. 30. 10	2. 18	9. 30. 10	2. 18
1. 3. 10		0. 27. 5		0. 22. 33	
8. 27. 0		9. 3. 5		9. 7. 37	
8. 28. 27	0. 54	9. 4. 57	0. 29	9. 9. 36	0. 13
1. 27	1. 24	1. 52	1. 49	1. 59	2. 5
Sun's Par. 8,80		Sun's Par. 8,73		Sun's Par. 8,09	
<i>Stockholm & Madrajs.</i>		<i>Upsal & Lejkard.</i>		<i>Upsal & Saville house.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
9. 30. 10	2. 18	9. 28. 6	2. 21	9. 28. 6	2. 21
4. 7. 44		1. 28. 58		1. 10. 56	
13. 37. 54		7. 59. 8		8. 17. 10	
13. 39. 38	0. 36	8. 0. 21	1. 4	8. 18. 22	1. 11
1. 44	1. 42	1. 13	1. 17	1. 12	1. 10
Sun's Par. 8,67		Sun's Par. 8,06		Sun's Par. 8,74	
<i>Upsal & Paris.</i>		<i>Upsal & Bologna.</i>		<i>Upsal & Rome.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
9. 28. 6	2. 21	9. 28. 6	2. 21	9. 28. 6	2. 21
1. 1. 10		0. 25. 5		0. 20. 33	
8. 26. 56		9. 3. 1		9. 7. 33	
8. 28. 27	0. 54	9. 4. 57	0. 29	9. 9. 36	0. 13
1. 31	1. 27	1. 56	1. 52	2. 3	2. 8
Sun's Par. 8,89		Sun's Par. 8,0		Sun's Par. 8,17	

<i>Upsal & Madrajs.</i>		<i>Calcutta & Saville house.</i>		<i>Calcutta & Paris.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
9. 28. 6	2. 21	14. 11. 34	2. 14	14. 11. 34	2. 14
4. 9. 44		5. 54. 14		5. 44. 28	
13. 37. 50		8. 17. 20		8. 27. 6	
13. 39. 38	0. 36	8. 18. 22	1. 11	8. 28. 27	0. 54
1. 48	1. 45	1. 2	1. 3	1. 21	1. 20
Sun's Par. 8",74		Sun's Par. 8",37		Sun's Par. 8",61	
<i>Calcutta & Bologna.</i>		<i>Calcutta & Madrajs.</i>		<i>Abo & Leskard.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
14. 11. 34	2. 14	14. 11. 34	2. 14	9. 45. 59	2. 30
5. 8. 23		0. 33. 34		1. 47. 5	
9. 3. 11		13. 38. 0		7. 58. 54	
9. 4. 57	0. 29	13. 39. 38	0. 36	8. 0. 21	1. 4
1. 46	1. 45	1. 38	1. 38	1. 27	1. 26
Sun's Par. 8,58		Sun's Par. 8,50		Sun's Par. 8,60	
<i>Abo & Rome.</i>		<i>Hernofand & Rome.</i>		<i>Calmar & Madrajs.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
9. 45. 59	2. 30	9. 28. 52	2. 26	9. 23. 40	1. 59
0. 38. 40		0. 21. 35		4. 14. 31	
9. 7. 19		9. 7. 17		13. 38. 11	
9. 9. 36	0. 13	9. 9. 36	0. 13	13. 39. 38	0. 36
2. 17	2. 17	2. 19	2. 13	1. 27	1. 23
Sun's Par. 8,50		Sun's Par. 8,88		Sun's Par. 8,91	
<i>Sherburne & Tornea.</i>		<i>Greenwich & Paris.</i>		<i>Greenwich & Leskard.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
8. 15. 12	1. 12	8. 19. 0	1. 11	8. 19. 0	1. 11
1. 40. 49		0. 9. 16		0. 18. 32	
9. 56. 1		8. 28. 16		8. 0. 28	
9. 54. 8	3. 5	8. 28. 27	0. 54	8. 0. 21	1. 4
1. 53	1. 53	17	17	7	7
Sun's Par. 8,50		Sun's Par. 8,50		Sun's Par. 8,50	

THE parallax of the Sun may also be deduced from the total duration of the Transit, as observed in different places, in the following manner.

<i>Tranquebar & Calmar.</i>		<i>Tranquebar & Upsal.</i>		<i>Tranquebar & Abo.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
5. 51. 33	6. 24	5. 51. 33	6. 24	5. 51. 33	6. 24
5. 50. 39	7. 21	5. 50. 26	7. 33	5. 50. 9	7. 46
54	57	1. 7	1. 9	1. 24	1. 22
Sun's Par. 8",05		Sun's Par. 8",25		Sun's Par. 8",71	
<i>Tranquebar & Cajaneburg.</i>		<i>Tranquebar & Tobolski.</i>		<i>Madrajs & Stockholm.</i>	
Parall.		Parall.		Parall.	
h. m. sec.		h. m. sec.		h. m. sec.	
5. 51. 33	6. 24	5. 51. 33	6. 24	5. 51. 43	6. 33
5. 49. 54	8. 5	5. 48. 50	9. 3	5. 50. 42	7. 34
1. 39	1. 41	2. 43	2. 39	1. 1	1. 1
Sun's Par. 8,23		Sun's Par. 8,67		Sun's Par. 8,50	

Madrajs.

<i>Madras & Tornea.</i>		<i>Great Mount & Abu.</i>		<i>Great Mount & Tobolski.</i>	
h. m. sec.	Parall.	h. m. sec.	Parall.	h. m. sec.	Parall.
5. 51. 43	6. 33	5. 51. 20	6. 33	5. 51. 20	6. 33
5. 50. 9	8. 7	5. 50. 9	7. 46	5. 48. 50	9. 3
1. 34	1. 34	1. 11	1. 13	2. 30	2. 30
Sun's Par. 8",50		Sun's Par. 8",26		Sun's Par. 8",50	
<i>Cajaneburg & Upsal.</i>		<i>Cajaneburg & Calmar.</i>		<i>Tobolski & Abu.</i>	
5. 49. 54	8. 5	5. 49. 54	8. 5	5. 48. 50	9. 3
5. 50. 26	7. 33	5. 50. 39	7. 21	5. 50. 9	7. 46
32	32	4. 45	44	1. 19	1. 17
Sun's Par. 8,50		Sun's Par. 8,70		Sun's Par. 8,72	

THE parallax of the Sun may also be determined, by comparing the times of the internal contacts, as observed in various places, with the time of their happening as observed at the center of the earth. For this purpose the following elements are used, as they were calculated by Mr. Short, from the measures made at the Transit in 1761, viz; the diameter of the Sun 31'. 31", the diameter of Venus 59", her horary motion 3'. 59", 8, the angle of her path 8'. 30". 10, the nearest dist. of their centers 9'. 32", and the diff. of their horizontal parallaxes 21", 35. Hence the ap. time of the 1st and 2d internal contacts was 2h. 22'. 3", and 8h. 20'. 4", reckoned by the meridian of Greenwich, without parallax, and the central duration was 5h. 58'. 1".

<i>Central Time & Upsal.</i>		<i>Central Time & Upsal.</i>		<i>Central Time & Hernosand.</i>	
h. m. sec.	Parall.	h. m. sec.	Parall.	h. m. sec.	Parall.
2. 22. 3	0. 0	2. 22. 3	0. 0	2. 22. 3	0. 0
1. 10. 26		1. 10. 26		1. 11. 28	
3. 32. 29		3. 32. 29		3. 33. 31	
3. 37. 56	5. 12	3. 37. 43	5. 12	3. 38. 35	5. 10
5. 27		5. 14		5. 4	
Sun's Par. 8",91		Sun's Par. 8",55		Sun's Par. 8",33	
<i>Central Time & Hernosand.</i>		<i>Central Time & Cajanel.</i>		<i>Central Time & Stockholm.</i>	
2. 22. 3	0. 0	2. 22. 3	0. 0	2. 22. 3	0. 0
1. 11. 28		1. 51. 50		1. 12. 26	
3. 33. 31		4. 13. 53		3. 34. 29	
3. 38. 26	5. 10	4. 19. 5	5. 6	3. 39. 29	5. 16
4. 55		5. 12		5. 0	
Sun's Par. 8,09		Sun's Par. 8,66		Sun's Par. 8,07	

Central

Central Time & <i>Abo.</i>	Parall.	Central Time & <i>Tornea.</i>	Parall.	Central Time & <i>Calmar.</i>	Parall.
h. m. sec.		h. m. sec.		h. m. sec.	
2. 22. 3	0. 0	2. 22. 3	0. 0	2. 22. 3	0. 0
1. 28. 33		1. 36. 48		1. 5. 39	
3. 50. 36		3. 58. 51		3. 28. 42	
3. 55. 50	5 16	4. 4. 0	5. 2	3. 33. 5	5. 22
5. 14		5. 9		5. 23	
Sun's Par. 8",44		Sun's Par. 8",69		Sun's Par. 8",52	
Central Time & <i>Tobolski.</i>		Central Time & <i>Madras.</i>		Central Time & <i>Calcutta.</i>	
2. 22. 3	0. 0	2. 27. 3	0. 0	2. 22. 3	0. 0
4. 32. 52		5. 20. 10		5. 53. 44	
6. 54. 55		7. 42. 13		8. 15. 47	
7. 0. 28	5. 28	7. 47. 55	5. 57	8. 20. 58	5. 16
5. 33		5. 42		5. 11	
Sun's Par. 8,63		Sun's Par. 8,14		Sun's Par. 8,36	

THE Sun's Parallax deduced from the observed and calculated Times of the 2d internal contact.

Central Time & <i>Spit. Squa.</i>	Parall.	Central Time & <i>Sav. House.</i>	Parall.	Central Time & <i>Paris.</i>	Parall.
h. m. sec.		h. m. sec.		h. m. sec.	
8. 20. 4	0. 0	8. 20. 4	0. 0	8. 20. 4	0. 0
0. 0. 17		0. 0. 30		0. 9. 16	
8. 19. 48		8. 19. 34		8. 29. 20	
8. 18. 41	1. 11	8. 18. 22	1. 11	8. 28. 27	0. 54
1. 7		1. 12		53	
Sun's Par. 8",01		Sun's Par. 8",62		Sun's Par. 8",34	
Central Time & <i>Bologna.</i>		Central Time & <i>Cape.</i>		Central Time & <i>Upsal.</i>	
8. 20. 4	0. 0	8. 20. 4	0. 0	8. 2. 4	0. 0
0. 45. 21		1. 13. 35		1. 10. 26	
9. 5. 25		9. 33. 39		9. 30. 30	
9. 4. 57	0. 29	9. 39. 50	6. 8	9. 28. 9	2. 21
28		6. 11		2. 21	
Sun's Par. 8,21		Sun's Par. 8,58		Sun's Par. 8,50	
Central Time & <i>Upsal.</i>		Central Time & <i>Upsal.</i>		Central Time & <i>Stockholm.</i>	
8. 20. 4	0. 0	8. 20. 4	0. 0	8. 20. 4	0. 0
1. 10. 26		1. 10. 26		1. 12. 26	
9. 30. 30		9. 30. 30		9. 32. 30	
9. 28. 7	2. 21	9. 28. 3	2. 21	9. 30. 11	2. 18
2. 23		2. 27		2. 19	
Sun's Par. 8,62		Sun's Par. 8,86		Sun's Par. 8,56	

Central

Central Time & Stockholm		Parall.	Central Time & Abo.		Parall.	Central Time & Cajanab.		Parall.
h. m. sec.			h. m. sec.			h. m. sec.		
8. 20. 4		0. 0	8. 20. 4		0. 0	8. 20. 4		0. 0
1. 12. 26			1. 28. 33			1. 51. 50		
9. 32. 30			9. 48. 37			10. 11. 54		
9. 30. 8		2. 18	9. 45. 59		2. 30	10. 8. 57		2. 59
2. 22			2. 38			2. 55		
Sun's Par. 8",75			Sun's Par. 8",95			Sun's Par. 8",31		
Central Time & Tobolski.		Parall.	Central Time & Calmar.		Parall.	Central Time & Rodrigues.		Parall.
h. m. sec.			h. m. sec.			h. m. sec.		
8. 20. 4		0. 0	8. 20. 4		0. 0	8. 20. 4		0. 0
4. 37. 52			1. 5. 39			4. 12. 34		
12. 52. 56			9. 25. 43			12. 32. 38		
12. 49. 20		3. 35	9. 23. 40		1. 59	12. 35. 47		3. 7
3. 36			2. 3			3. 9		
Sun's Par. 8,54			Sun's Par. 8,78			Sun's Par. 8,59		
Central Time & Calcutta.		Parall.			Parall.			Parall.
h. m. sec.								
8. 20. 4		0. 0						
5. 53. 44								
4. 13. 48								
14. 11. 34		2. 14						
2. 14								
Sun's Par. 8,50								

THE Sun's parallax is also found, by comparing the total duration between the internal contacts, as it was observed in different places, with the duration at the center of the earth, viz. 5^h. 58'. 1".

Cent. Duration & at Upsal.		Parall.	Cent. Duration & at Upsal.		Parall.	Cent. Duration & at Upsal.		Parall.
h. m. sec.			h. m. sec.			h. m. sec.		
5. 58. 1		0. 0	5. 58. 1		0. 0	5. 58. 1		0. 0
5. 50. 7		7. 33	5. 50. 2		7. 33	5. 50. 26		7. 33
7. 54			7. 59			7. 35		
Sun's Par. 8",89			Sun's Par. 8",98			Sun's Par. 8",54		
Cent. Durat. & at Calmar.		Parall.	Cent. Dur. & at Hernostrand.		Parall.	Cent. Dur. & at Hernostrand.		Parall.
h. m. sec.			h. m. sec.			h. m. sec.		
5. 58. 1		0. 0	5. 58. 1		0. 0	5. 58. 1		0. 0
5. 49. 54		8. 5	5. 50. 26		7. 36	5. 50. 17		7. 36
8. 7			7. 35			7. 44		
Sun's Par. 8,53			Sun's Par. 8,48			Sun's Par. 8,65		
Cent. Dur. & at Stockholm.		Parall.	Cent. Dur. & at Stockholm.		Parall.	Cent. Dur. & at Abo.		Parall.
h. m. sec.			h. m. sec.			h. m. sec.		
5. 58. 1		0. 0	5. 58. 1		0. 0	5. 58. 1		0. 0
5. 50. 45		7. 34	5. 50. 42		7. 34	5. 50. 9		7. 46
7. 16			7. 19			7. 52		
Sun's Par. 8,16			Sun's Par. 8,22			Sun's Par. 8,61		

Cent,

Cent. Dur. & at <i>Cajaneb.</i>	Cent. Dur. & at <i>Tobolski</i>	Cent. Dur. & at <i>Tranqueb.</i>
Parrall.	Parall.	Parall.
h. m. sec.	h. m. sec.	h. m. sec.
5. 58. 1	5. 58. 1	5. 58. 1
5. 49. 54	5. 48. 50	5. 51. 33
8. 7	9. 11	6. 28
Sun's Par. 8",53	Sun's Par. 8",63	Sun's Par. 8",59
Cent. Dur. & at <i>Madrafs.</i>	Cent. Dur. & at <i>Calcutta.</i>	Cent. Dur. & at <i>Gr. Mount</i>
5. 58. 1	5. 58. 1	5. 58. 1
5. 51. 43	5. 50. 36	5. 51. 20
6. 18	7. 25	6. 41
Sun's Par. 8,17	Sun's Par. 8,40	Sun's Par. 8,67
Cent. Dur. & at <i>Tornea.</i>		
5. 58. 1		
5. 50. 15		
8. 7		
7. 46		
Sun's Par. 8,13		

THE mean of all the preceeding determinations of the Sun's parallax is 8",52 on the day of the Transit, in June 1761, which gives 8",65 for his horizontal parallax at his mean dist. from the earth.

MR. Stuart of Glasgow, whom I mentioned before, deduces the parallax and distances of the bodies that compose the solar system, from the Newtonian theory of gravitation, and the periodical times of the Sun and Moon. As he proceeds upon the supposition that the distance of the Sun from the earth is very great, it would therefore seem, that the conclusion should be accurate, in proportion to the greatness of that distance. His method depends upon a series of propositions, with long and difficult demonstrations; so that the rules of calculation are not very obvious, without a considerable knowledge of geometry, in general, and a particular acquaintance with his very useful and ingenious treatise. I was desirous of seeing what agreement there was between the result of his method of calculation, and the Observations made on the Transit of Venus; and therefore amused myself in a leisure hour with the comparison. As it may be agreeable to some, who have not time to read over the book, and to others, whose acquaintance with the mathematics will not admit of it, to have the practical rules

rules of computation deduced from his propositions; I shall annex them to the foregoing calculations, together with the determination of the Sun's parallax and distance derived from them.

A Calculation of the horizontal Parallax and Distance of the Sun, according to Mr. Stuart's Method, from the Principles of Gravitation.

1. As the cube root of the square of the Moon's periodic revolution round the Earth, viz. $\left. \begin{array}{l} \text{As the cube root of the square of the} \\ \text{Moon's periodic revolution round the} \\ \text{Earth, viz.} \end{array} \right\} \overline{27,32162036}^{\frac{2}{3}}$

Is to the cube root of the square of her revolution from apogee to apogee, viz. $\left. \begin{array}{l} \text{Is to the cube root of the square of her} \\ \text{revolution from apogee to apogee, viz.} \end{array} \right\} \overline{27,554535}^{\frac{2}{3}}$

So is 1, to a fourth number, which call A.

2. As $5A-3 : A-1 :: 1 : \text{a fourth number, which call B.}$

3. As the rectangle of B and the square of the periodic time of the Earth round the Sun, viz. $\left. \begin{array}{l} \text{As the rectangle of B and the square} \\ \text{of the periodic time of the Earth round} \\ \text{the Sun, viz.} \end{array} \right\} B \times \overline{365,2564}^2$

Is to the square of the periodic time of the Moon round the Earth, viz. $\left. \begin{array}{l} \text{Is to the square of the periodic time of the} \\ \text{Moon round the Earth, viz.} \end{array} \right\} \overline{27,32162036}^2$

So is 1, to a fourth number, which call $C = 1,999840899$.

4. As $\overline{C-1}^2 : 12 :: C : \text{to a fourth number; to which add 1, and from the square root of that sum subtract 1, and multiply the remainder by the half of } C-1, \text{ or } 0,4999204495, \text{ and call that product } D = 1,9999715505.$

5. Subtract D from 2, multiply the remainder by D, and call the square root of the product E.

6. As three times the Moon's mean distance from the Earth, in semidiameters of the Earth is to E, so is R. to the tang. of the Sun's hor. parallax at his mean distance $= 8'',65$.

7. As $E : 3 :: \text{the Moon's mean dist. in miles} : \text{the Sun's mean dist. in miles} = 94982600.$

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IN

IN determining the parallax of the Sun, from the observation made in our Observatory on the 3d of June, 1769; I have only made use of the time of the internal contact, as I noted it on that day, together with some of my own Micro-meter observations, without attending to those of the other gentlemen who observed with me. But, as the Society has a right to expect a full account of the result of the other Observations, which were made on that occasion; and as such account may tend to corroborate the foregoing calculations, I have, with Dr. Williamson's permission, subjoined a calculation of his, founded entirely on his own Observation, which being very short, I have inserted entire in his own words, except what refers to the manner in which he judged of the contacts, &c. which I have transcribed in another place, (see page 48.) From this, which is very similar to the Observations made by the other gentlemen on that committee, the Society will perceive, that our Observations must have been made with considerable accuracy, as the result of the calculation is nearly the same.

*Dr. WILLIAMSON's Determination of the PARALLAX of the
SUN, from his Observation of the TRANSIT of VENUS,
at Philadelphia, June 3d, 1769.*

“**W**ITH a Refracting Telescope, 24 feet long, which magnified near 100 times, I observed,
 The ext. contact at 2^h. 11'. 31" }
 Int. Do. at 2. 19. 10 } Mean Time.

“ WITH a Micrometer of Dollond’s construction, fitted to a Gregorian Reflector, which magnified 100 times, I measured the dist. of Venus from the limb of the Sun ; also the diameters of the Sun and Venus, as follows :

Mean Time.			Nearest Distance of the Centers of ☉ & ♀.		Nearest Distance of the Limbs of ☉ & ♀.		
	h.	m.	sec.	m.	sec.	m.	sec.
At	5.	43.	17	10.	14, 12	5.	2, 53
	6.	32.	18	11.	14, 19	4.	1, 46
	6.	33.	55	11.	13, 23	4.	3, 42
	7.	9.	26	12.	11, 83	3.	5, 82
I MEAN.							

" I MEASURED the diam. of Venus on the Sun, and found it to be $55'.42$. I also frequently measured the diam. of the Sun, on the day of observation, and the next day, and found it to be $31'.31''.30$.

" FROM these data, I shall attempt to deduce the Sun's par. except that I shall make no use of the measure at $6^h. 32'. 18''$, which I suspected was not accurate at the instant it was made, wherefore I immediately made another measure, viz. at $6^h. 33'. 55''$.

" THE nearest dist. of the limb of the Sun from that of Venus at $5^h. 43'. 17''$ } mean time compared together,
And at $6^h. 33'. 53''$ }
give the apparent nearest dist. of their centers $10'. 3''. 7$, or $603''. 7$, and the parallax of Venus was at that time south $6''. 91$ nearly. Therefore, the geocent. nearest dist. of their centers was $610''. 61$. Then,

" As $72626,3$ the relative nearest dist. of Venus from the Sun,

" Is to $28894,9$ her dist. from the Earth.

" So is $610''. 61$ the geocent. nearest dist. of the cent. of the Sun and Venus,

" To $242''. 936 = 4'. 2''. 936$, the heliocent. dist. of their centers at the nearest approach.

" As Sine $3^\circ. 23'. 20''$ the given inclin. of Venus's orbit to the ecliptic: Is to Radius,

" So is S, $242''. 936$, the heliocent. dist. of the cent. of the Sun from Venus, at the middle of the transit,

" To the Sine of $410''. 5 = 1^\circ. 8'. 25''$, the Sun's dist. from the node of Venus at the ecliptical conjunction.

" As S, of $1^\circ. 8'. 25''$, the Sun's dist. from the node of Venus,

" Is to $10'. 10''. 61$, the geocent. nearest dist. of their centers.

" So is Rad: to the S, of $8^\circ. 32'. 57''. 6$, the angle of Venus's visible path with the ecliptic.

" FROM $8^\circ. 32'. 57''. 6$, the angle of Venus's visible path,

" SUBT. $3. 23. 20$, the inclination of Venus's orbit with the eclipt. and the remainder is $5^\circ. 9'. 37''. 6$. Then

As

" As S, $5^{\circ}. 9'. 37'',6$ the diff. of the angle of Venus's visible path and the inclin. of her orbit, &c.

" Is to S, $8^{\circ}. 32'. 57'',6$ the angle of Venus's visible path with the eclipt.

" So is $2',392375$ the given hor. motion of the Sun.

" To $3',95412$ the hor. motion of Venus.

" As Rad. Is to T, $8^{\circ}. 32'. 57'',6$ the angle of Venus's visible path.

" So is S, $1^{\circ}. 8'. 25''$ the Sun's dist. from the node of Venus.

" To T, $10'. 17'',2$ Venus's geocent. latitude.

" As $72626,3$ the relative dist. of Venus from the Sun,

" Is to $28894,9$ her distance from the Earth.

" So is $617'',2$ her geocent. latitude.

" To $245'',56$ her heliocent. latitude.

" FROM $15'. 45'',65$ the semid. of the Sun,

" TAKE $27'',71$ the semid. of Venus, and the difference is $15'. 17'',94$, the dist. of the center of the Sun from the center of Venus at the inter. contact. But the geocent. nearest dist. of their centers was found $610'',61$. From these (p. Euc. 1. 47) the length of half the transit line between the int. contacts is found to be $685',397$ which divided by the hor. motion of Venus gives the semiduration of the transit between the two internal contacts $2^h. 53'. 20'',2$.

" In the same manner, from the geocent. lat. of Venus, and the nearest dist. of her center from the center of the Sun, we find the time of Venus passing from the eclipt. conjunction to the middle of the transit $22'. 44'',9$. Then from $5^h. 28' 47''$, which I find to be the central time of the middle of the transit, deduct $22'. 44'',9$, and the remainder, viz. $5^h. 6'. 2'',1$, will be the apparant time of the ecliptical conjunction when the Sun's place was $2^s. 13^{\circ}. 27'. 20'',5$, as calculated by the Astronomer Royal, on the supposition that our Observatory is west of Greenwich $5^h. 0'. 35''$.—To the Sun's place in the eclipt. add his dist. from the node of Venus $1^{\circ}. 8'. 25''$. The sum is $2^s. 14^{\circ}. 35'. 45'',5$, the place of Venus's ascending node.

FROM

“ From the micrometer measures above given, it appears that the center of Venus was at her nearest approach to the center of the Sun at $5^{\text{h}}. 21'. 44''$ mean time, or $5^{\text{h}}. 23'. 59''$ appar. time. But on account of the parallax of Venus, the appar. time at the center of the Earth was $4'. 48''$ later, which brings it to $5^{\text{h}}. 28'. 47''$ as I have mentioned. From this deduct the semidurat. $2^{\text{h}}. 53'. 20$, and the remainder $2^{\text{h}}. 35'. 27''$ is the time of the internal contact at the center of the Earth. This contact I observed as above, at $2^{\text{h}}. 29'. 10''$ mean time, or $2^{\text{h}}. 31'. 25''$ apparent time. This difference, therefore, viz. $4'. 2''$, is the observed effects of Venus's parallax both in latitude and longitude.

“ BUT on the supposition that the Sun’s horizontal parallax, at her mean dist. from the Earth was $8''.65$, as Mr. Short has stated it at the former Transit, then his horizontal parallax, on the 3d of June, the day of the Transit, would have been $8''.5204$, in which case the total effect of her parallax, to hasten the internal contact at Philadelphia, should be $4'. 1''$. Therefore,

"As $4'.1''$ is to $4'.2''$, so is $8''.5204$ to $8''.556$, the Sun's horizontal parallax on the day of the Transit, according to the foregoing Observations.

"HENCE we have $8''.685$, the Sun's horizontal parallax at his mean distance from the Earth. Then say,

“ As the T, of the Sun's horizontal parallax : is to the semi-diameter of the Earth,

“ So is Rad. to the distance of the Earth from the Sun, viz. 94791100 English miles, taking the Earth’s mean semi-diameter at 3985.4 miles.

M

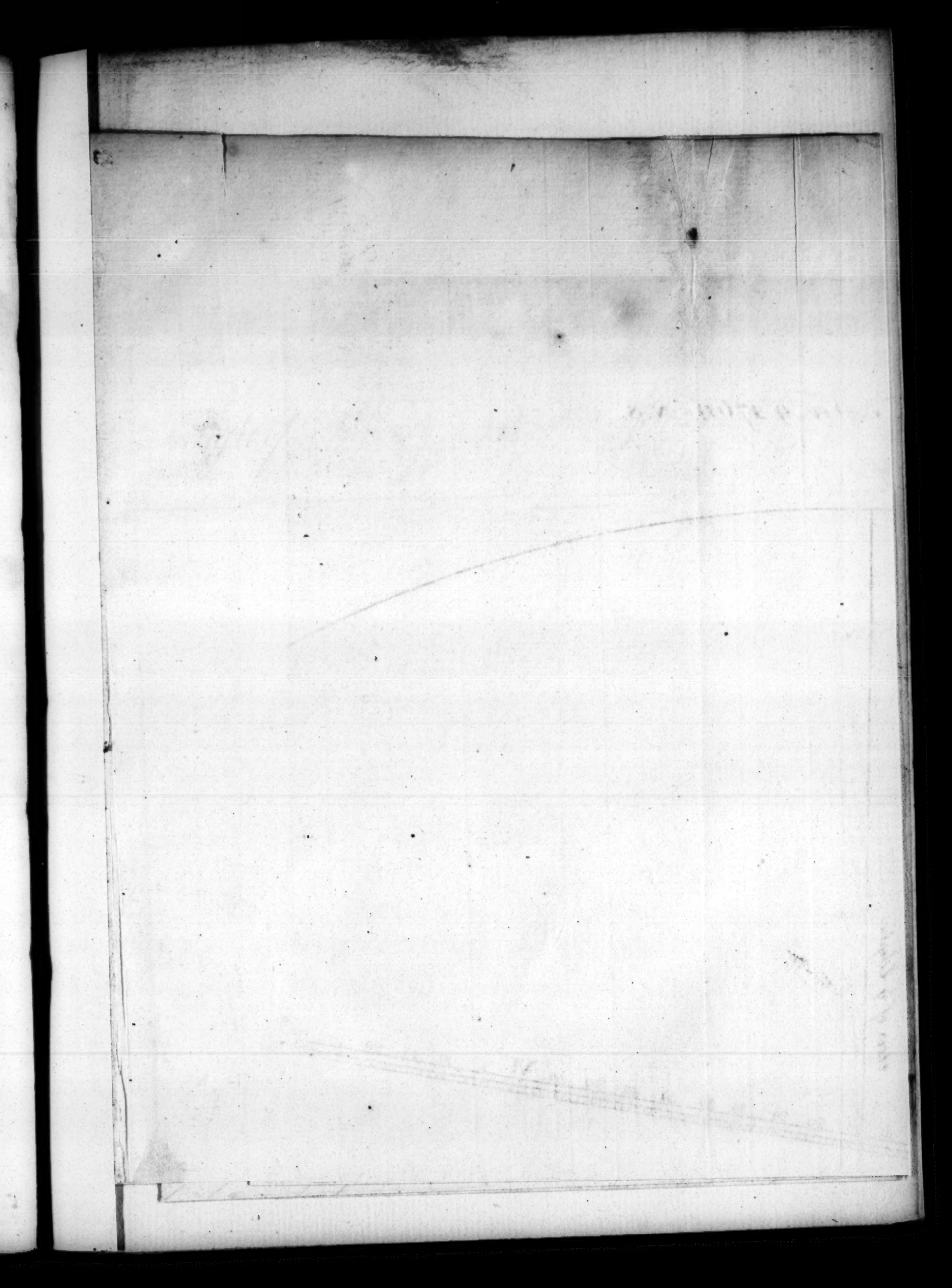
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N. B.	Page 78.	For Int. Contact	H.	min.	sec.
			2.	19.	10
		Read	2.	29.	10

*An Account of the Transit of MERCURY over the SUN,
on November 9th, 1769. N. S.*

IN the judgment of most Astronomers, the transits of Mercury and Venus over the Sun afford the best opportunities, for settling the longitudes of places on the earth, even preferable to that derived from the eclipses of Jupiter's satellites, when the parallax of the Sun is previously known. Those of Mercury happen frequently, and although they are of but little importance in determining the parallax of the Sun and the dimensions of the solar system, by reason of his great distance from the earth, and the difference of their parallaxes being less than that of the Sun; yet they have been carefully observed, for the purpose of settling his theory, and the longitudes of the places of observation. The Society therefore, sensible of the importance of this phenomenon, both to the perfection of astronomy in general, and particularly for completing the purposes designed to be answered by the observation of the transit of Venus, have appointed the same committee, with the addition of two other gentlemen, to observe the transit of Mercury on the 9th of November, 1769, in *Philadelphia*, that had been before appointed to observe that of Venus.

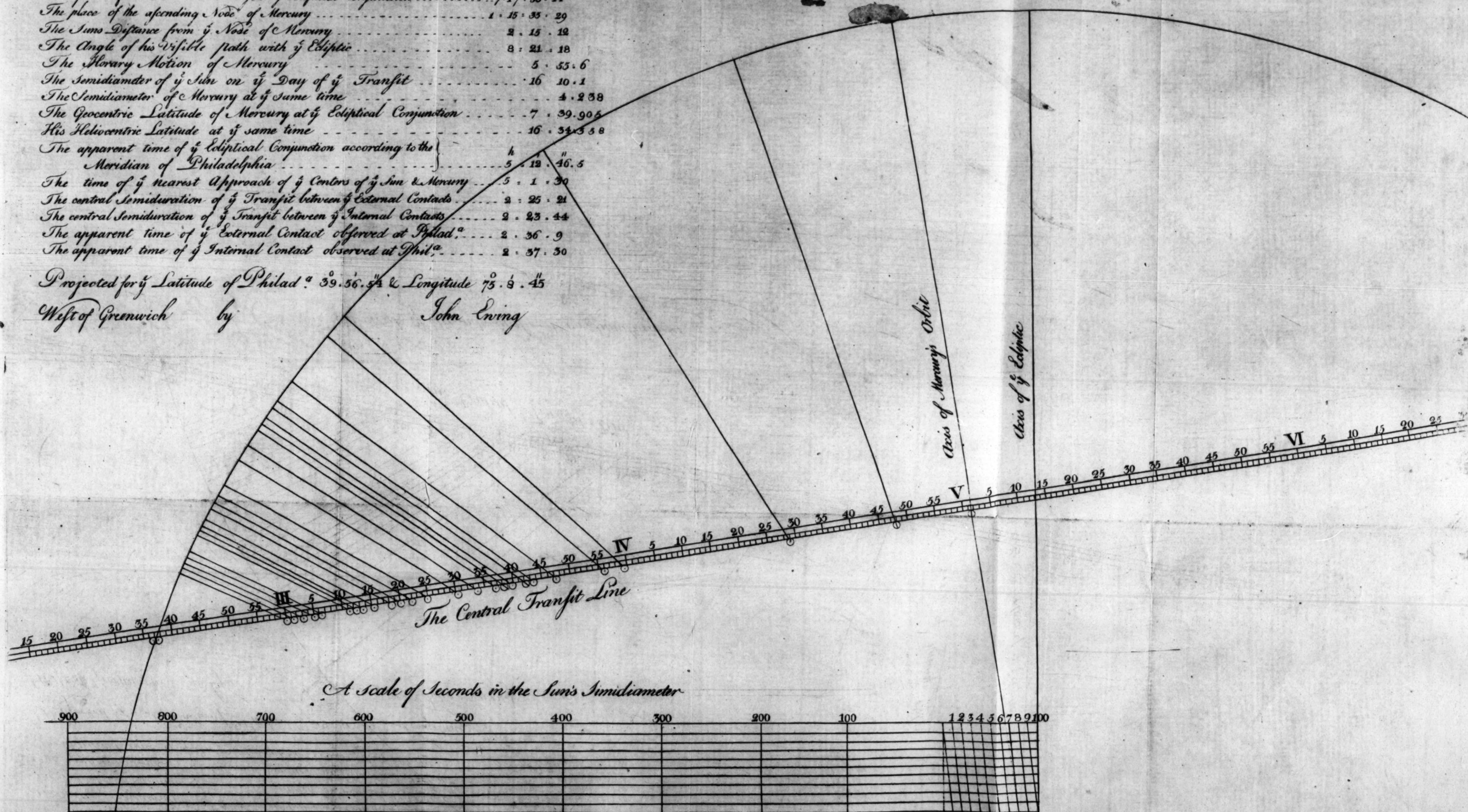
HAVING still the same instruments in our Observatory, which we used on the former occasion, together with a new Time-Piece made by Mr. *Duffield* of this city, with an ingenious contrivance of his, in the construction of the pendulum, to remedy the irregularities arising from heat and cold; we paid the utmost attention to the going of the clock, both before and after the transit. From comparing a sufficient number of corresponding altitudes of the Sun's limbs, we found that our clock was too slow for mean time $1'. 20''$ and the equation of time being $15'. 49''.6$ or to avoid fractions $15'. 50''$; $17'. 10''$ were added to the times of all our observations, as they were wrote down in the Observatory, to reduce them to apparent time. In this manner we obtained the time of the subsequent observations. Dr. *Williamson*, Mr. *Shippen* and myself used the same Telescopes, we had used before in observing the transit of Venus; excepting that on this occasion I chose
that

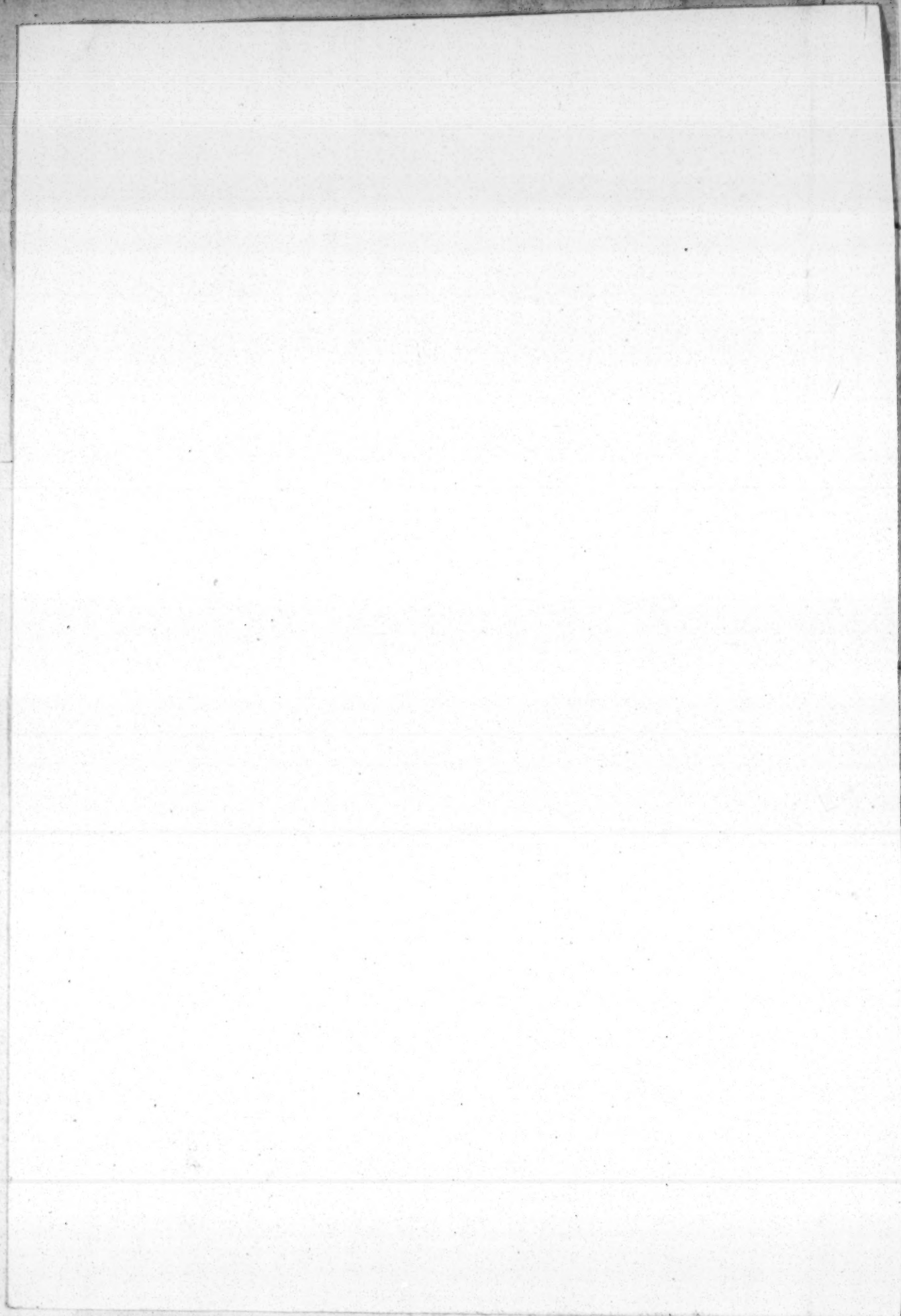


A Projection of the Transit of Mercury over the Sun, observed at Philad^a. Nov. 9 1769. N.S.

The place of the Sun & Mercury at γ Ecciptical Conjunction	7. 17. 50. 42
The place of the ascending Node of Mercury	1. 15. 35. 29
The Sun's Distance from γ Node of Mercury	2. 15. 12
The Angle of his visible path with γ Ecciptic	8. 21. 18
The Hourly Motion of Mercury	5. 53. 6
The Semidiameter of γ Sun on γ Day of γ Transit	16. 10. 1
The Semidiameter of Mercury at γ same time	4. 23. 8
The Geocentric Latitude of Mercury at γ Ecciptical Conjunction	7. 39. 90. 6
His Heliocentric Latitude at γ same time	16. 34. 3. 8
The apparent time of γ Ecciptical Conjunction according to the Meridian of Philadelphia	5. 12. 46. 5
The time of γ nearest Approach of γ Centers of γ Sun & Mercury	5. 1. 30
The central Semiduration of γ Transit between γ External Contacts	2. 25. 21
The central Semiduration of γ Transit between γ Internal Contacts	2. 23. 44
The apparent time of γ External Contact observed at Philad ^a	2. 36. 9
The apparent time of γ Internal Contact observed at Phil ^a	2. 37. 50

Projected for γ Latitude of Philad^a 39. 56. 54 & Longitude 75. 3. 45
West of Greenwich by John Ewing





that power of the Telescope which magnifies the diameters of objects an hundred times. Mr. *Evans* used the Reflecting Telescope formerly used by Mr. *Biddle* at the Capes.

On the day of the transit, we assembled together at the Observatory, adjusted our Telescopes to distinct vision, appointed an assistant to count the clock with an audible voice, and agreed that no other person should speak, nor move from his Telescope, until both contacts were over; but write down his own observation separately by himself, that it might be compared with the others. The sky being very serene, and the limb of the Sun well defined in our Telescopes, we observed the contacts, as they are exhibited in the following table.

Observers.	External Cont.	Int. Cont.	Par. in Vert.	Par. p. to his P.	Par. in his Path.
	h. m. sec.	h. m. sec.	"	"	"
<i>Dr. Williamson,</i>	2 36. 5 Ap. T.	2. 37. 30	3,74	3,44	1,48 at the External
<i>Mr. Shippen,</i>	2. 36. 12	2. 37. 40			Contact.
<i>Mr. Evans,</i>	2. 36. 9	2. 37. 38	3,745	3,44	1,49 at the Internal
<i>Myself.</i>	2. 36. 9	2. 37. 30			Contact.

I HAPPENED to have that part of the limb of the Sun, on which Mercury entered, in the middle of the field of my Telescope, with my eye intent upon it; so that I am certain that there was not the least impression on the Sun's limb, perceptible by my Telescope, a single second of time before I discovered it. So that I am not surprized that Dr. *Halley*, who had observed a transit of Mercury in the island of *St. Helena*, concluding that, that of Venus would be equally instantaneous, expected, that the contact of her limb with the Sun might be determined to a single second of time. The atmosphere of Venus renders it quite otherwise, and produces an uncertainty of 5 or 6 seconds of time in judging of the contacts; whereas no such thing was perceptible in Mercury. The first appearance of Mercury, on the Sun's limb, was a steady small speck, black, well-defined, and not larger (in my Telescope) than the dot of a pen. But that of Venus was tremulous, obscure, and ill-defined, growing gradually darker as she advanced on the Sun. If Mercury has an atmosphere, it must be so rare and low, that his distance from us renders it absolutely imperceptible.

ceptible with the Telescopes that we used. At the internal contact, the crescent of light round the body of Mercury closed instantaneously, so that it might be judged of with more precision than that of Venus; his atmosphere giving us no disturbance in this case. We could not have a fairer opportunity, for ascertaining the truth of these conclusions; as our telescopes were in good order, and well adjusted, and the sky was remarkably clear and serene on both of these days. On the first of them, not a cloud appeared from morning till evening, and on the latter, none till about four o'clock, when the Sun was very low; and both the transits began between two and three o'clock, in the afternoon.

ABOUT three o'clock, I applied myself to the Micrometer to measure the diameters of the Sun and Mercury, and the nearest distance of their limbs, while Dr. *Williamson* read off the divisions of the Micrometer, and a third person wrote them down, with the times of making them. These measures make the diameter of the Sun on the 9th of *November* 1769, $32'. 20'', 2$ or his semidiameter $970'', 1$ seconds, and the semidiameter of Mercury $4'', 238$. The measures of the least distances of their limbs reduced to minutes and seconds of a degree, with the parallaxes of Mercury adapted to the apparent times of the observations, as they are determined from a very large projection of two inches to a second of his hor. parallax, are set down in the following table.

Apparent Time.			Nearest Dist. of	Par. of ☿ in	Par. per. to	Par. in his
h. m. sec.			Limbs of ☉ & ☿	the Ver,	his Path,	Path,
2.	59.	40	1. 54,1	3,81	3,4	1,725
3.	1.	0	2. 0,62	3,81	3,396	1,73
3.	2.	35	2. 8,284	3,82	3,393	1,745
3.	4.	30	2. 20,832	3,825	3,39	1,765
3.	6.	10	2. 26,048	3,826	3,386	1,78
3.	10.	33	2. 48,216	3,835	3,38	1,83
3.	12.	6	2. 57,244	3,841	3,379	1,84
3.	12.	56	3. 2,56	3,844	3,376	1,85
3.	15.	4	3. 13,744	3,850	3,375	1,865

Apparent

Apparent Time.	Nearest Dist. of	Par. of γ in	Par. per. to	Par. in his
	Limbs of $\odot$ & γ	the Ver.	his Path,	Path,
h. m. sec.	' "	"	"	"
3. 18. 4	3. 26,032	3,856	3,369	1,87
3. 19. 18	3. 30,596	3,86	3,366	1,888
3. 21. 30	3. 41,68	3,864	3,363	1,915
3. 24. 0	3. 51,684	3,875	3,36	1,95
3. 30. 0	4. 20,8	3,895	3,34	2,0
3. 33. 30	4. 35,144	3,90	3,338	2,02
3. 36. 40	4. 51,444	3,905	3,334	2,04
3. 37. 40 }				
3. 39. 25 }	5. 2,202	3,915	3,33	2,065
3. 41. 10 }				
3. 42. 50 }	5. 21,406	3,930	3,325	2,09
3. 46. 58	5. 37,184	3,935	3,32	2,145
3. 55. 32	6. 8,48	3,96	3,30	2,2
3. 59. 10	6. 26,084	3,97	3,29	2,24
4. 28. 50	7. 54,756	4,0	3,22	2,42
4. 47. 50	8. 35,18	4,02	3,15	2,51

N. B. IN the above Table, the measure at $2^h. 37'. 40''$ was taken between the nearest limb of the Sun and the interior limb of Mercury nearest to the Sun's center, and is $5'. 2'', 202$, the same with the distance of their nearest limbs at $3^h. 39'. 25''$: So also the distance between the nearest limb of the Sun, and the interior limb of Mercury, at $3^h. 41'. 10''$, was the same with the distance of their nearest limbs at $3^h. 42'. 50''$, viz. $5'. 21'', 406$. The same is to be said of the last measure, which was taken from the nearest limb of the Sun to the limb of Mercury nearest to the Sun's center.

IF a computation be made from the above measures, the apparent nearest distance of their centers will be found to be $451'', 914$. But Mercury was then depressed by parallax $3'', 11$; so that the geocentric nearest approach of their centers was $455'', 024$, which happened at $5^h. 1'. 15''$ ap. time, when his par. in the vert. was $4'', 042$, and in his path $2'', 53$, and perpend. to his path $3'', 11$.

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THE horary motion of Mercury as seen from the Earth is also determined from the above measures to be $5'. 56'', 941 = 5'', 94856$, which is nearly the same with what is given by Dr. Halley's tables of Mercury. On the day of the Transit, he moves, by them, at the rate of $15'', 334$ per hour. The Sun's horary motion on that day is stated in the Nautical Almanac at $2'', 516$, and their difference, viz. $12,818$ is his hor. motion from the Sun, as seen at that distance. Then say,

As the dist. of γ from $\odot$, is to his dist. from $\odot$, So is this hor. mot. to his hor. mot. from $\odot$, as seen from $\odot$

4. 830,2920

4. 495,3305

1. 107,8203

5. 603,1508

0. 772,8588 = $5', 92733 = 5'. 55'', 5398$ γ 's hor. mot. from $\odot$, as seen from $\odot$.

15. 334

2. 516

17. 850 = 1. 251,6382

12. 818 = 1. 107,8203

11. 214,2067 = } the log. cot. of half the incl. of γ 's orbit
with the ecliptic = $\frac{1}{2} 6^\circ. 59'. 20''$.

12. 322,0270

Log. Tang. 11. 070,3888 = $85^\circ. 8. 22''$

86. 30. 20

171. 38. 42

8. 21. 18 = the angle of γ 's visible path

with the ecliptic.

As Rad : Sec, $8^\circ. 21'. 18'' ::$ geo. nearest dist : the geo. lat. of γ

10. 000,0000

10. 004,6342

2. 658,0343 = $455'', 024$ = geo. nearest dist.

2. 662,6685 = $459,905 = 7'. 39'', 905$ = geo. lat. of γ

As dist. of γ from $\odot$: his dist. from $\odot ::$ geo. lat. : his heliocent. latitude

4. 495,3305

4. 830,2920

2. 662,6685

7. 492,9605

2. 997,6300 = $994'', 558 = 16'. 34'', 558$ the hel. lat. of γ

As.

As T, 6°. 59'. 20" : R :: T, 16'. 34". 558 : Sine of ☉'s dist. from the node of ♃

9. 088,4133

10. —

7. 683,0140

8. 594,6007 = 2°. 15'. 12". 2 ☉'s dist. from the node of ♃

459,905

455,024

914,929 = 2. 961,3873

4,881 = 0. 688,5088

3. 649,8961

1. 824,94805 = 66". 8264 = { the length of part of the transit line between the middle of the transit & the ecl. conjunct.

2. 551,0104 ♃'s hor. motion in seconds.

— 1. 273,9376 = 0h. 187905 = 0h. 11'. 16". 458 the time between the middle and ecliptical conjunction.

974,338 the sum of the semidiameters of ☉ and ♃

455,024 the geo. nearest dist. of their centers.

1429,362 = 3. 155,1422

519,314 = 2. 715,4300

5. 870,5722

2. 935,2861 = 861". 561 { half the length of the transit line from the external contact.

2. 551,0104 = the hor. mot. of ♃ on ☉, as seen from ☉

0. 384,2757 = 2h. 422567 = 2h. 422567 = 2h. 25'. 21". 24 the femiduration from the external contact.

965,862 the dist. of the semidiameters of ☉ and ♃

455,024 the geo. nearest dist. of their centers.

1420,886 3. 152,5691

510,738 3. 708 2833

5. 860,8524

2. 930,4262 = { 851,974 = the length of half the transit line from the internal contact.

2. 551,0104

0. 379,4158 = 2h. 39561 = 2h. 23'. 44". 196

Now to 2h. 36'. 9" the time of the exter. contact,

Add 2. 25. 21 the femidur. between the external contacts.

The Sum, 5. 1. 30 is the time of the nearest approach of their centers;
To this add, 11. 16,5 the time from the middle to the ecl. conjunct.
The Sum, 5. 12. 46,5 is the ap. time of the ecl. conjunct. at Philad.
To this add, 5. 0. 35 the diff. of merid. between Greenw. & Philad.
The Sum, 10. 13. 21,6 is the time of the ecl. conjunction at Greenw. when

when the Sun's place, according to the Nautical Almanac, is $7^{\circ} 17' 50'' 41'''$, and that of Mercury is, $1^{\circ} 17' 50'' 41'''$, by Dr. Halley's tables. From this subtract $2^{\circ} 15' 12''$, the Sun's dist. from the node of Mercury, and the remainder $1^{\circ} 15' 35'' 29'''$, is the place of his node at that time.

The PROJECTION of the TRANSIT of MERCURY. Pl. V.

THE following projection of the Transit of Mercury over the Sun, on the 9th of November, 1769, was made from the foregoing measures and calculations, on the supposition that the Sun's horizontal parallax, at his mean distance is, $8''.65$, and therefore, $8''.7437$ on the day of the Transit. In this case, the horizontal parallax of Mercury, at his mean distance, will be $14''.1132$, and on the day of the Transit $12''.7856$, and therefore his horizontal parallax from the Sun, on that day is, $4''.0419$, being the difference of their parallaxes.

THE delineation was made in the same manner as that of the Transit of Venus. The elements for it were collected from the preceeding calculation, and the parallaxes of Mercury were measured upon a very large projection, for that purpose, adapted to the apparent times of the Micrometer measures, and applied to the projection. By these, the apparent places of Mercury were determined, as seen at Philadelphia; and small circles were drawn round them, with the Radius $4''.238$, to represent his disc, on the face of the Sun. From the limbs of the Sun and Mercury, lines were drawn, in the direction of their centers, of the precise length exhibited in the foregoing table of measures.

UPON the whole, I have given a full and faithful account of our Observations of the Transits of Venus and Mercury, in the foregoing sheets; and if they should be found, in the conclusion, to contribute any thing to the advancement of Astronomical Knowledge, it must reflect an honor on our new Observatory, and give pleasure to all the Lovers of Science, as well as to,

Gentlemen,

Your most obedient

And very humble Servant,

Philadelphia, July 19th, 1769.

JOHN EWING.

An Account of the TRANSIT OF VENUS, over the Sun's Disc, as observed near Cape-Henlopen, on Delaware Bay, June 3d, 1769.

By OWEN BIDDLE, JOEL BAILEY, and RICHARD THOMAS.

Drawn up, By OWEN BIDDLE.

A GREEABLE to the appointment of the *American Philosophical Society*, to observe the *Transit of Venus* at the Light-House, near Cape-Henlopen, I set out by water from Philadelphia, accompanied by Joel Bailey, and Richard Thomas, the latter of whom had offered to accompany us at his own expence, and proved very serviceable in the assistance he gave us.

ON the 26th of the 5th Month (May) we arrived at *Lewes-Town*, and immediately endeavoured to gain such information as might enable us to determine the best place for our Observations; and, on mature deliberation, we fixed on a place about one quarter of a mile S. W. of the town of *Lewes*, where a convenient house was to be had, in a retired situation, and having an open view of the sky.

WE found on our first landing on the beach, that neither the *Light-House*, nor any place near the sea-shore, would be suitable for our Observations; as it would be difficult to keep our instruments steady, or defend either the glasses of the Telescopes, or the eyes of the observers, from receiving injury by the sand which is wafted about by the wind.

HAVING chosen our place, we fixt up our instruments on the 27th of the month, and had some good corresponding altitudes of the Sun that day, by which we set our clock, and took some equal altitudes of fixt stars in the evening. The four following days continued cloudy, with frequent rains. But that we might not be idle in the mean time, and have it in our power to ascertain our latitude and longitude, in case we should be disappointed of celestial observations for that purpose; Joel Bailey and Richard Thomas, went to take the courses and distances from our place of Observation, to the provincial west line, which was run from Fenwick's Island to the *middle Point* of the peninsula; so that our *Observatory* might thereby be connected with Messrs. Mason and Dixon's meridian line.

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THE 1st of the 6th month (June) my associates returned from this service; and by their care and skill, I make no doubt, they performed it with the necessary precision.

WE had concluded that it would be a more expeditious way to take the courses, &c. from our Observatory to the west line, rather along the nearest public road than to run in one direct course through the woods; as by this last method, both the expence and delay of opening a vista, would have been necessary.

As the fixing the latitude and longitude of our Observatory must depend chiefly on this part of the work, I shall here insert the field notes, before I proceed to draw the conclusions from them. And I think it the more necessary to be particular in this request, that I may comply with the desire of the Astronomer Royal, express'd in his note to Dr. Franklin, as follows, viz.

Greenwich, December 11, 1769.

" Mr. Maskelyne presents his compliments to Dr. Franklin,
 " and shall be obliged to him, when he writes to Philadelphia, for
 " enquiring of Mr. Owen Biddle, what is the bearing and what
 " the absolute distance of Lewestown from the Stone on Fenwick's
 " Isle in English miles; or else what is the difference of latitude
 " and departure in English miles? He may also, if he pleases,
 " acquaint Mr. Biddle, that the latitude of the Middle Point
 " between Fenwick's Isle and Chesapeake Bay, as found by Messrs.
 " Mason and Dixon, is $38^{\circ} 27' 34''$; and the length of a
 " degree of latitude, as measured by them is 68,896 statute miles.
 " Mr. Maskelyne would also recommend it to Dr. Smith, and
 " the other Norriton-Observers, to settle the bearing and dis-
 " tance in English miles between Norriton and the southermost
 " point of the city of Philadelphia, or else the State House square;
 " as this will still further confirm the situation of the Norriton-
 " Observatory, by connecting it with Messrs. Mason and Dixon's
 " Meridian Line.

" Mr. Maskelyne hopes, the Pennsylvania-Observers will be
 " so kind as to send us their Observations of the TRANSIT OF
 " MERCURY, which happened November 9th, if they were for-
 " tunate enough to see it; and any other Observations, they have
 " made, which have not yet been sent here, tending to establish the
 " difference of longitudes."

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The COURSES and DISTANCES from the Observatory near Lewestown, to the Provincial West Line, between Fenwick's-Isle and Chesapeake-Bay, are as follows.

Courses.	Dist. in Perches.	Courses.	Dist. in Perches.	Courses.	Dist. in Perches.
S. 43. 5 W.	495	S. 27. 15 W.	171	S. 10. 0 W.	56
S. 7. 30 E.	51	S. 43. 0 W.	23	S. 14. 0 E.	111
S. 45. 27 W.	446	S. 64. 0 W.	58	S. 23. 0 E.	54
S. 74. 0 W.	70	S. 50. 0 W.	26	S. 75. 0 E.	25
S. 68. 15 W.	44	S. 20. 40 W.	78	S. 64. 0 E.	65
S. 45. 0 W.	31	S. 30. 0 W.	41	S. 29. 0 E.	22
S. 35. 30 W.	52	S. 39. 0 E.	74	S. 13. 10 E.	81
S. 28. 0 W.	32	S. 44. 0 W.	52	S. 39. 0 E.	61
S. 82. 15 W.	56	S. 21. 30 W.	69, 67	S. 9. 0 W.	24
N. 76. 0 W.	38	Acrofs Indian River.		S. 6. 0 E.	36
S. 42. 5 W.	102	S. 65. 0 W.	131	S. 25. 0 W.	84
S. 27. 0 W.	57	S. 64. 0 W.	78	S. 21. 30 E.	40
S. 64. 0 W.	33	S. 79. 0 W.	76	S. 40. 0 E.	57
S. 44. 0 W.	46	N. 80. 0 W.	52	S. 18. 0 E.	26
S. 2. 0 W.	45	S. 85. 30 W.	42	S. 12. 0 E.	78
S. 10. 0 W.	138	N. 76. 0 W.	63	S. 40. 0 W.	96
S. 30. 30 W.	216	S. 86. 0 W.	70	S. 10. 50 W.	86
S. 28. 40 W.	76	S. 65. 0 W.	66	S. 13. 0 E.	56
S. 25. 0 W.	104	S. 24. 0 W.	50	S. 28. 0 W.	70
South. - -	55	S. 18. 45 W.	73	S. 16. 10 E.	48
S. 8. 0 W.	96	S. 12. 0 E.	24	S. 6. 0 E.	26
S. 19. 5 W.	56	S. 6. 0 E.	48	S. 8. 0 W.	59
S. 26. 0 W.	80	S. 11. 0 E.	174	S. 22. 0 E.	46
S. 27. 30 W.	159	S. 6. 0 E.	73	S. 2. 0 W.	20
S. 8. 0 W.	270	S. 10. 0 W.	38	S. 42. 0 E.	42
S. 29. 0 W.	58	S. 11. 0 E.	112	S. 22. 0 E.	30
S. 11. 20 E.	164	S. 6. 0 E.	35	S. 48. 0 W.	46
S. 25. 0 E.	44	S. 19. 0 W.	16	S. 14. 0 E.	21
S. 28. 30 E.	58	S. 13. 0 W.	22	S. 18. 0 E.	48
S. 40. 30 E.	200	S. 29. 0 W.	46	S. 12. 30 E.	52
S. 30. 5 E.	45	S. 50. 0 E.	145	S. 42. 0 E.	49
S. 40. 5 E.	76	S. 61. 0 E.	48	S. 40. 0 E.	44
S. 58. 0 E.	44	S. 10. 0 E.	36	S. 14. 0 E.	110
S. 10. 0 W.	58	S. 21. 30 W.	110	South - -	31
S. 18. 0 E.	42	S. 10. 0 W.	56	S. 40. 0 E.	26
S. 12. 0 E.	84	S. 8. 30 E.	55	S. 14. 0 E.	22
S. 14. 0 E.	178	S. 27. 30 E.	34	S. 22. 0 W.	27
S. 10. 0 E.	44	S. 12. 0 E.	38		
S. 5. 30 E.	56	S. 10. 0 W.	30		
S. 21. 0 E.	60	S. 28. 0 W.	30		
S. 41. 0 W.	62	S. 38. 0 W.	75		
S. 21. 0 W.	40				
S. 5. 0 W.	18				

Here the Line from Fenwick's Isle to the Middle Point was intersected at 9 miles 86 perches, from the stone in Fenwick's Isle.

The Needle, with which these Courses were taken, being compared with our Meridian Line, and also with the Prov. W. Line, was found to have 3°. 55'. Variation W. which was allowed for in reducing the Work. HENCE

HENCE, from the above work, we get the Observatory near Lewestown,

West of the Stone on Fenwick's Isle 1895,5 perches, = 5 miles 295,5 perches.

East of the middle point, - - - 9286,3 perches, = 29 miles 6,3 perches.

North of the middle point, - - - 7007,5 perches, = 19° 4' 3".

The latitude of the middle point is, - - - 38° 27' 34"

The sum is the latitude of the Observatory, 38. 46. 38,3

THUS the latitude of the Observatory was fixed, and so would its longitude have been fixed by the above work also; if we had known either the longitude of the Middle Point, or of the Stone on Fenwick's Isle. But this not appearing from any part of the work of Messrs. Mason and Dixon, left among their public papers in this province, the AMERICAN PHILOSOPHICAL SOCIETY ordered us in the 5th Month, [May,] 1770, to take the Courses and Distances from New-Castle Court-House, to the Observatory in the State-House square, by which means the middle point, and consequently our Observatory at Lewes might be connected with the Philadelphia and Norriton Observatories, and so the longitude of the two latter being known; the longitude of the former would be known also. Our work is as follows.

COURSES. Begun at the Center of New-Castle Court-House,	Distance in Perches.	Courses.	Perches.	Courses.	Perches.
N. 39°. 0 W.	3,52	N. 43. 30 E.	258	N. 69. 0 E.	189
N. 32°. 40' E.	40	N. 45. 15 E.	168	N. 57. 0 E.	116
N. 42. 00 E.	50	N. 52. 30 E.	98	N. 37. 40 E.	438
N. 6. 50 E.	80	N. 60. 20 E.	232	N. 58. 0 E.	406
N. 1. 50 W.	153	N. 78. 20 E.	225	N. 47. 35 E.	120
N. 19. 0 E.	729	N. 62. 5 E.	132	N. 11. 40 E.	66
N. 16. 30 E.	328	N. 69. 0 E.	188	N. 55. 15 E.	42
N. 12. 30 E.	66	N. 71. 0 E.	135	S. 73. 20 E.	38
N. 7. 0 E.	192	N. 43. 0 E.	105	N. 83. 30 E.	37
N. 42. 0 E.	56	N. 58. 0 E.	112	S. 70. 40 E.	162
N. 19. 0 W.	50,22	N. 67. 45 E.	123	N. 73. 30 E.	45
North. - - -	89	N. 49. 0 E.	105	N. 50. 30 E.	790
N. 2. 0 W.	181	N. 74. 0 E.	140	S. 88. 15 E.	100
N. 7. 0 E.	56	N. 64. 0 E.	76	S. 71. 50 E.	189
N. 35. 0 E.	20	N. 59. 0 E.	132	S. 87. 0 E.	104
N. 59. 55 E.	944	N. 73. 15 E.	148	N. 55. 0 E.	432
N. 41. 50 E.	87	N. 58. 30 E.	93	S. 77. 40 E.	325,8
N. 51. 30 E.	276	N. 26. 30 W.	32	South. - - -	18
N. 49. 0 E.	48	N. 56. 30 E.	136	To the center of the Observatory in the State-House-square.	
		N. 5. 0 E.	124		
		N. 35. 25 E.	126		
		N. 61. 0 E.	280		
		N. 62. 15 E.	320		

N.B. The variation of the Needle, by which these Courses were taken was, 3°. 15' West, which was allowed for in reducing the Work.

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Thus by the above work we get—		Perches
Newcastle Court-house West of Philadelphia Observatory		7011,5
Middle Point of Peninsula West of New-Castle Court-house		2212,2
Their sum gives the middle point W. of Philad. Observatory		9223,7
But (p. 92) the Middle Point is W. of the Lewes Observatory		9286,3
Their difference gives the Lewes Observatory East of the Philadelphia Observatory	}	62,6
This difference of sixty two perches does not give quite a second of time difference of longitude.		
And as, both by the Philadelphia and Norriton observations, the longitude of the Philadelphia Observatory, West of Greenwich, is	3h. 0. 35"	
The longitude of Lewes Observatory, West of Greenwich, is in time	3h. 0. 34"	
Or, in degrees and parts of the equator, the longitude of Lewes Observatory W. of Greenwich is	75°. 8. 30"	
And its latitude as above	38. 46. 38,3	North

For the advantage of navigation, we also took the courses and distances from our Observatory to the Provincial *Light-House* near the Cape; and on reducing the work, we find the Light-House North of our Observatory 182,83 perches, = 29", 8; and East of the same 944 perches = 3'. 16", 8.—Whence

The latitude of the Light-House, is	38°. 47'. 8", 1	North
And its longitude, W. of Greenwich	75°. 5'. 13", 2	

I now proceed to give an account of the remainder of our observations. The 2d of the Month we had several good corresponding altitudes of the Sun for setting our Time-piece.

THE 3d being the *Transit-Day*, was as fine in every respect for our Observation, as we could desire; the air calm, and not a cloud in view. We had a series of good corresponding altitudes of the Sun, taken in season, not to interrupt the Observation of the Transit.

ABOUT 12 o'clock we directed our Telescopes to the Sun, determined to keep it constantly in the field, till the contacts should be past; and in the mean time we set our boys (whom we had tutor'd for that purpose) to count the seconds by the clock, each boy counting one minute alternately, least they should be wearied, and not perform it with sufficient exactness. During the whole a person was standing by to overlook them, calling out each minute as it elapsed, and noting it down.

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WE

WE had agreed with each other to attend to our Telescopes one minute by turns, until about 7 or 8 minutes before the expected time, least by too steady attention, we should impair our sight, and disable ourselves from discerning the contact clearly. I had left my Telescope the minute preceding the contact, intending to apply myself steadily to it before the minute was fully elapsed; and not to quit it again until the contact occurred. When the 48th second was called, I applied myself to the Telescope, and by the time three seconds more were elapsed, I perceived on that part of the Sun's limb, where I had expected the contact to take place, a small impression, which proved to be the limb of Venus in contact with the Sun. All the limb of the Sun which appeared at that time in the field of the Telescope had a small undulatory motion, which I apprehended was occasioned by the ascent of dense vapours at this place (being near the sea). On the first appearance of Venus, it was like one of these small waves on the limb of the Sun, enlarged in so small a proportion, that I remained doubtful for several seconds, whether it was any thing besides. It continued making a deeper impression with that tremulous motion for about 10 seconds, when the tremor disappeared where Venus was in contact, and the indenture became truly circular with an even termination.

My absence from my Telescope, just before the contact occurred, deprived me of the opportunity of judging whether there was any appearance of an atmosphere preceeding the western limb of Venus as it came in contact; but when Venus had entered near one half her diameter on the disc of the Sun, my companion and I both saw a luminous crescent, which enlightened that part of Venus's circumference which was off the Sun, so that the whole of her circumference was visible; but it did not continue so, until the first internal contact took place.

At the time of the internal contact, agreeable to what was noted by some of the observers at the transit 1761; "the eastern limb of Venus seemed to be united to the limb of the Sun by a black protuberance or ligament, which was not broke
by

by the entrance of the thread of light," until 4 seconds after the regular circumference of Venus seemed to coincide with the Sun's.

For this observation I used a reflecting Telescope, magnifying about 150 times, which was in exceeding good order at the time, and defin'd the limb of the Sun, and spots on its disk, very nicely. I had applied a Polar Axis to it, and had altered the rack work, by which I could keep the same part of the limb in the field with ease.

My companion Joel Bailey was not so well provided with a Telescope. He had one of *Dollond's* double object lens refracting glasses of about four and an half feet length. This, with a ball and socket, was fixt to a post, which made it very convenient for observation. Thus furnished we found the contacts take place as follows.

JOEL BAILEY's external contact was lost by an accident, but seen by him after it had taken place, at 2^h. 14'. 30" Ap. T.

THE internal contact, by Do. 2. 32. 8

EXTERNAL contact, as seen by Owen } 2. 14. 8
Biddle, - - - - - }

THE internal contact by Do. 2. 32. 8

THESE Observations are reduced to appar. time. And it must be noted, that the time of the internal contact, as given by Owen Biddle, is 4 seconds before the thread of light had broke the dark ligament by which Venus's limb was united to the limb of the Sun, that being the time he estimated the two limbs to be in contact. Also, that as the internal contact occurr'd speedily after he went to his Telescope, he will not presume to assert that he has the time to a single second, yet he conceives he has given the exact time of that contact, as he is not sensible of any error therein.

THE foregoing being an exact diary of our Transactions, we submit the same to the Society, and hope for their approbation.

OWEN BIDDLE.

P. S. Since the foregoing was drawn up, I received from Dr. Smith the following note; which gives me pleasure to find so little difference between the result of Charles Mason and Jeremiah Dixon's measurement and our own.

Dear Sir,

" SINCE you finished your measurement from Newcastle Court-house to the Philadelphia Observatory in the State-house Square, the 58th vol. of Philos. Transac. has come to hand, containing the whole work of Messrs. Mason and Dixon in measuring a *degree of latitude*; and it is with great pleasure I find, that the longitude of the middle point of the peninsula (and consequently of your Observatory at Lewes) in respect to Philadelphia, will come out almost entirely the same from their work as from yours, altho' obtained by different *routs. LONGITUDE of the Middle Point, and of the Lewes Observatory West of the Philadelphia Observatory, agreeable to the Lines of Messrs. Mason and Dixon.

Observatory in the Forks of Brandiwine West of the South	}	miles. chains. lin.
point of the city of Philadelphia		31. 00. 00
Middle point of Peninsula East of Observatory in the Forks	}	2. 5. 49
The diff. gives the middle point of Penins. W. of S. point of Philad.		28. 74. 51
But S. point of Philad. is E. of Observatory in State-house Square	}	0. 28. 75
The difference gives the middle point of Peninsula West of State-house Observatory		28. 45. 76
But by your work the middle point is W. of the Lewes Obs.	}	9286,3 = 29. 1. 57
The difference gives Lewes Observatory East of the State-house Observatory, from Mason and Dixon's Lines		0. 35. 81
But by your measure to Newcastle the Lewes Observatory was East of the State-house Observatory 62,6 perches	}	0. 15. 65
So that Mason and Dixon's lines give your Observatory more E. than your own work, only		0. 20. 16

Thus, by their work, we get your Observatory not quite 2", and by your own, not quite 1" East of the Observatory in the State-house Square. Wherefore 1" being taken as a mean, and applied to 5h. 0'. 35" the longitude of the State-house Observatory West of Greenwich; the longitude of the Lewes Observatory may be well depended on as stated from your own work, to be in time West of Greenwich 5h. 0'. 34"

N. B. As British mariners generally take their departure from the land's-end of England, and as by Mr. Bradley's observation of the late Transit of Venus the long. of the Lizard Point is now determined to be 5°. 15' W. of Greenwich; if that be subtracted from 75°. 5'. 13", 2, it will give----

The longitude of the Provincial Light-house near the Capes West of Lizard Point } 69°. 50'. 13". 2

If you think the above can be of any use, you may add it to the end of your account. I think there is no mistake in bringing out the different results; but if I can find leisure I will re-examine the work before the sheet is struck off.

Philad. 23d July, 1770.

I am, with great regard, yours, &c.

To Mr. OWEN BIDDLE,

WILLIAM SMITH.

* The result by Mr. Biddle's book is got, by going from the State-House Observatory to New-Castle Court-House, agreeable to his measurement; thence by the 12 m. radius and tangent line to the middle point. The result by Messrs. Mason and Dixon's work is got, by beginning at the south point of the city of Philadelphia, (or the place of their Observatory,) on the north side of Cedar-Street, between Front-Street and Delaware; thence to their Observatory in the Forks of Brandiwine, which is 31 miles West, and 10, 2/3 South of the southernmost point of the city; thence by the other lines of latitude and departure, wherewith they connect the Observatory in the Forks of Brandiwine, with the middle point of the Peninsula. See their work in the vol. of Transactions, quoted above.

An Abstract of Mr. BENJAMIN WEST's Account of the Transit of Venus, as observed at Providence, in New-England, June 3d, 1769.

AS it appears by some letters of the Astronomer Royal, which have been communicated to this Society, that most of the Northern Observers, both in Russia and Sweden, were greatly disappointed, by the unfavourable state of the weather, in their noble and public spirited endeavors to observe the late Transit; the American Observations have become of the greater importance, in order to a comparison with those of Greenwich, and therefore the Society think it very material to preserve in their Transactions, such of the Observations made on this Continent as they have been favored with. The Account of the Providence Observations, drawn up by Mr. WEST, was transmitted by Mr. JOSEPH BROWN, and being laid before the Society by Dr. SMITH; the following Abstract thereof was ordered to be published at a Meeting, May 18th, 1770.

WHEN it became more generally known that there would be a Transit of Venus in 1769, and the advantages which were like to accrue to Astronomy, and consequently to Navigation and Chronology, from proper observations of it, Mr. JOSEPH BROWN*, a very respectable merchant of Providence, being very desirous, if possible, to obtain an observation of it, was pleased to advise with me, concerning an apparatus suitable for such an observation, and to know if we should be able to observe the transit with the necessary precision for answering the important design? My answer gave him so much satisfaction in the matter, that he immediately sent his orders to his correspondent in London,

* Reading Mr. Winthrop's account of the transit in 1761, was what first occasioned Mr. BROWN to send for a telescope, fitted in the manner Mr. Winthrop there describes; afterwards, taking notice of the application of the American Philosophical Society to the Assembly of Pennsylvania, for an apparatus for observing the Transit of Venus, he found the orders he had sent were incompleat: He then advised with the author, as mentioned above, and thereupon ordered a micrometer to be added.—Mr. Brown's expence, in this laudable undertaking, was little less than One Hundred Pounds sterling, besides near a month's time of himself and servants, in making the necessary previous experiments and preparations.

don, to procure the instruments. His orders were accordingly executed with fidelity and dispatch; and the instruments arrived in Providence about one month before the transit. Our apparatus was made by Messieurs Watkins and Smith, London; it consisted of a three feet reflecting telescope, with horizontal and vertical wires for taking differences of altitude and azimuths, adjusted with spirit-levels at right angles, and a divided arch for taking altitudes; a curious helioscope, together with a micrometer of a new and elegant construction, with rack motions, and fitted to the telescope. Besides the beforementioned instruments, we had a sextant belonging to the government, made in Newport, by Mr. Benjamin King, under the direction of Joseph Harrison, Esq; now Collector of his Majesty's Customs for the port of Boston; its limb was divided to five miles, and by a vernier index to five seconds. We had two good clocks, one of which was made in Providence, by Mr. Edward Spalding."

"We had nothing to learn respecting the apparatus, excepting our new catadioptric micrometer, which, I have lately learned, is of Dollond's construction; not having any author by us, from which we could get the use of that curious instrument, we were obliged to have recourse to experiments. When the micrometer was fixed upon the telescope, it was found by trial, that objects could not be seen with the same focal distance as when it was off, and we were obliged to screw up the small speculum nearer to the eye; for which there is an optical reason. From whence it was concluded, that objects should always be observed in the most distinct point of view, the same with the micrometer on as when it was off. The next thing to be done was to find the apparent diameter of an object (or the angle subtended at the eye by two objects) by this instrument. In order to this, we stretched a cord, as straight as possible, one thousand feet in length; which was measured

§ And here we must not forget the Hon. Abraham Redwood, Esq; of Newport, who, in order that Newport and Providence might both be supplied with a sextant, for this singular occasion, ordered one made at his own cost, for the use of the Revd. Dr. Stiles. I am sensible Mr. Redwood, for so public spirited an action, will receive the thanks of every well-wisher to science.

measured several times over, in order to avoid mistake. At the end of the cord was set two circular objects, made of white paper, in a line perpendicular to the cord, and exactly ten feet apart; standing at the other end of the cord, and by opening the micrometer, we could bring the two images into an exact coincidence, or could make one of the images appear like two, and by bringing their limbs into contact, the distance of their centers was shewn on the scale, to the five hundredth part of an inch. Now from the rules of trigonometry, the angular distance of the two objects was $34^{\circ}. 22'. 58''$; from thence it was known, how many inches and parts of an inch were answerable to that angle. These experiments were repeated every fair day (for no other was suitable for these observations) till we could many times going find the diameter of a body to a second of a degree. From these observations we were enabled to make a table for the micrometer, as far as the scale extended. These experiments were carried yet farther; for, by looking at two bodies whose distance from each other was known, we could tell their distance from the place of observation, to a critical exactness; and this was proved by accurate mensuration. These were certainly very diverting experiments to an inquisitive mind! The gentlemen who assisted us through these experiments, and likewise in the rest of our work, were the Hon. Stephen Hopkins, Esq; Mr. Moses Brown, Dr. Jabez Bowen, Joseph Nash, Esq; and Capt. John Burroughs."

"THE regulation of our clocks, being of the utmost consequence in this affair, was what next commanded our attention. In this part of the work we endeavoured to arrive at as great a degree of certainty as the nature of the case would admit.--- Several workmen were employed in laying a platform, of seasoned pine plank, as smooth and level as art could make it: This was secured from rain, or other moisture, that it might not warp when exposed to the Sun. We examined this platform three times a day (when the weather would admit of it) with a very long level. On the south side of the platform, and exactly perpendicular to it, we erected a stile ten feet high; this was likewise examined three times a day. We next perforated

forated a piece of board, into which was fixed the glass of a scioptric ball, so that the center of the glass was exactly in the center of the perforation; this board was so cut, and let in at the top of the stile, that it turned upon an axis, in such a manner, that the center of the glass did not alter its position. The Sun's rays were transmitted through the lens upon the platform, where they were formed into a bright spot, and very distinctly defined. From the center of the lens was let fall a perpendicular upon the platform; from that point, as a center, was drawn a great number of concentric circles, for taking correspondent shades, in order to trace a meridian line; and, as our wishes would have it, the weather proved favourable for this work. When the line was drawn†, I found, from calculation, it declined 3" in time, east of the true meridian; this error arose from the increase of the Sun's declination, between the times of forenoon and afternoon shades; this small equation of 3" was allowed for in regulating the clocks."

"As we were willing to have every corroborating circumstance to prove our work, we made use of the method of corresponding altitudes of the Sun, forenoon and afternoon. The sextant and reflector were both employed in this business for several days preceeding the transit (and the day following) in order to ascertain the going of the clocks. In the last method (as in that of corresponding shades) the equation of time, answerable to the increase of declination, ought by no means to be neglected. The whole process was conducted with the utmost caution, that no errors might escape our notice. We found upon the whole, a surprizing agreement in these two methods of regulating clocks; they were seldom found to differ a single second."

"BEING in this readiness, the morning of the third of June was ushered in with that serenity the business of the day required; all was calm, and not a cloud to be seen. The gentlemen concerned in the business convened very early at the place

† The magnetic needle, being placed on his exact meridian line, was found to differ from it $6^{\circ} \frac{1}{2}$ westward.

place of observation, to see that every thing was in order; and at the sight of such a morning, the gladness of their heart was visibly expressed, by the pleasure of their countenance."

" AT noon we examined the going of the clocks, as the Sun passed the meridian, and found them very regular."

" WE began to look for the first contact of Venus with the Sun, at least 15 minutes before the time given by calculation, to get as early a sight of it as possible. Venus was first perceived, by making a dent upon the superior limb of the Sun, at 2^h. 29'. 43". P. M. apparent time. But, as it is likely the exterior contacts will be given different, by different observers, they can be of but little consequence in this affair. The greatest attention was given to the interior contact; this was at 2^h. 46'. 35". apparent time||. From a mean of a number of good observations, the apparent diameter of the Sun was 31'. 40'',66, and that of Venus 58''66; though I could not make it myself more than 58'', which was the same we found it about a fortnight before the transit. The proportion of their diameters was nearly as 1 to 33. The nearest approach of their centers, at the middle of the transit, was taken with the micrometer, and found to be 10'. 5'."

" THE proportion of the distances of the Sun and Venus from the earth, at that time, was as 3,5143 to 1; then (allowing the Sun's parallax at his mean distance to be 8'',68 the same
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|| At the moment of interior contact, the Sun's altitude was taken, with the sextant, by Mr. Moses Brown, and by the stile by Capt. John Burrough; and both gave the time with the clocks within two seconds. The total ingress was not so instantaneous as I did expect it would be, but the bright cusps of the Sun, as they incompassed Venus, were much more obtuse, and there seemed to be a faint junction of their limbs for at least 4 seconds; the moment this penumbral ligament broke, I proclaimed the time; at first I suspected the telescope was not adjusted to a proper focus; but afterwards, by looking at the solar spots, &c. I was convinced of the contrary. During the time we saw Venus upon the Sun, she appeared to be surrounded by a ring of a yellowish colour; its width was about one tenth of the diameter of Venus. We saw nothing that might be taken for a satellite.

it was found the 6th of June, 1761) the parallax of Venus was $30'.04$; the difference of their parallaxes $21'.49$ is the parallax of Venus from the Sun. The angle between the visible way of Venus and the ecliptic, $8^\circ.34'.17''$; and the angle made by the axis of the ecliptic and equator, $7^\circ.3'.7''$; their sum, $15^\circ.37'.24''$, was the angle between the axis of the visible way of Venus, and the Earth's axis. The transit line, from total ingress to the middle of the transit (measured in time by the visible motion of Venus) was $2^h.55'.36''$; but Venus was more accelerated in her orbit (by parallax in longitude) at the middle of the transit, than at total ingress; this difference of acceleration was $1'.33''$; therefore from the total ingress to the middle of the transit was $2^h.54'.3''$.

THENCE I conclude, that the

* First contact was at	- - -	$2^h.28'.0''$	} app. time.
But seen by us, as above, at	- - -	$2.29.43$	
Interior contact,	- - -	$2.46.35$	
Middle of the transit,	- - -	$5.40.38$	

"VENUS's parallax in longitude, at the middle of the transit, was $18''.7$; this was passed over by Venus's visible motion in $4'.44''$; so that the middle of the transit, as seen from the center of the earth, was at $5^h.43'.6''$ mean time. The true conjunction was $23'.21''$ before the middle of the transit, as seen from the earth's center; consequently the true conjunction was at $5^h.19'.45''$, mean time. At which-time, the place of the Sun and Planet was *Gemini* $13^\circ.27'.3''$; and the geocentric latitude of Venus $10'.19''.8$ north. But her heliocentric latitude was $4'.6''.51$; and by the rules of spherical trigonometry, the ascending node of Venus was $1^\circ.9'.23''.5$ in consequence of the Sun, or in *Gemini* $14^\circ.36'.26''.5$ "

"FROM the foregoing calculation it appears, that the mean motion of Venus is $37''$ forward of what it stands in Dr. Halley's tables, and her ascending node $2'.41''$."

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* When I calculated this transit, I supposed the longitude of our place to be much less than we have since found it by observation. By correcting that error, the error in calculation will appear to be inconsiderable.

"It is probable Dr. Halley's solar numbers need some correction likewise; the following may not be far from truth, viz. add to Dr. Halley's mean motion of the Sun, for any year of the Christian æra, $25''$, and to the apogee $6'. 18''$; for each century after 1700 add $14'', 666$ to the mean motion, and to the apogee $3'. 53''$; then by making use of the Parisian equation of the Sun's center, his place may be had within a small matter of truth."

"By taking the mean of a number of observations, the latitude of our observatory was found to be $41^{\circ}. 50'. 41''$ north. The longitude was obtained by observing the emersions of Jupiter's satellites, compared with the corresponding observations made at Cambridge, in New-England, by Mr. Winthrop, which he was so kind as to favour us with; and for which we return him our sincere thanks. Providence was found to be $16'$ in longitude west from Cambridge. Mr. Winthrop has hitherto found the longitude of Cambridge to be 71° . west from the Royal Observatory at Greenwich; so that the longitude of Providence is about $71^{\circ}. 16'$ from the Royal Observatory."

"I SHALL now give the reader a short account of the parallax herein mentioned, and how the planets are affected thereby."

"THE horizontal parallax of the Sun is that angle at the Sun's center, which is included between two lines supposed to be drawn, one from the Sun's center to the center of the earth, the other from the Sun's center to the surface of the earth. Or,
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¶ According to the Parisian hypothesis, the eccentricity of the earth's orb is 1680 parts, of which the mean distance of the earth from the Sun is 100,000.

§ The latitude of the place being of great consequence, and the sextant and stile not giving it exactly alike, the persevering Mr. Brown contrived to make use of the micrometer as a lens, which he placed on his house, twenty seven feet high, and exactly perpendicular to a center on a horizontal platform below, on which was drawn a meridian line; the Sun's image on this platform was seen to move very sensibly. By this the latitude was finally determined. The Sun's meridian altitude, being taken for several days by this long stile, the latitudes thence found did not differ from each other more than 15 seconds. At the time this was done, we had seen no account that a glass had been made use of, as here described; but since this went to the press, we learn from Dr. Long's astronomy, that he found the latitude of Cambridge, in England, by the same method.

in other words, it is the angle, under which the semidiameter of the earth would appear to an eye, at the center of the Sun. The way that parallax affects the Sun and Planets is, it makes them appear below their true places in the heavens, except they be in the zenith of the observer; in that case parallax hath no effect at all; and the reason is, because the observer is in that right line which joins the centers of the earth and planet. Parallax may affect the planets places several ways; as if the observer should view the planet upon a vertical, cutting the ecliptic at right angles; in this case, parallax will affect its place in respect to latitude only; but if the observer be situated in the plane of the ecliptic, it will then alter its place, in respect to longitude only; and if the planet be viewed in an oblique position, with respect to the ecliptic, parallax will affect its place both in longitude and latitude. The horizontal parallaxes of the planets are to each other in a reciprocal proportion to their distances; that is, the planets which are nearest have the greatest parallax, and those which are most remote, the least. Thence it follows, if two planets are viewed together, that which is nearest will appear just so much below the other, as what the difference of their parallaxes is. The nearer a planet is to the horizon of the observer, the greater is its parallax, and in the horizon it is the greatest possible; and is then called the horizontal parallax."

"HENCE comes the method of investigating the Sun's parallax, from observations of Venus on his disc. At the time of the transit, the third day of June, Venus was much nearer to the earth than the Sun was, and, of consequence, was much more affected by parallax. This effect was produced in a two-fold manner, in respect to us in the northern regions of our earth. First, Venus was depressed upon the Sun, by parallax in longitude, bringing her to a conjunction with the Sun sooner to our point of view, than to a spectator at the center of the earth. In the second place, she was carried nearer to the center of the Sun, by parallax in latitude, thereby lengthening the transit-line; both which effects conspired to accelerate the time of first interior contact. Now to an observer in Great-Britain, parallax had a still greater effect, by what is said before: That is, some minutes passed after the contact was formed to the observer

observer there, before it was seen by us. Now the difference of longitude, between the two places of observation, being accurately known, the effect of parallax, between the two places, is likewise known; for the difference of longitude, by these observations, will be considerably less than the true difference."

"THE method of calculating the Sun's parallax, from these observations, is by trial; the parallax will be supposed of that quantity, which the observations found it in 1761; hence the total effect of parallax, at each place of observation, must be computed; and if it should be the same as given by observation, it will prove the assumption to be just; but if, by observation, it should be greater or less than by calculation, the Sun's parallax will turn out to be greater or less in the same proportion.---When the Sun's parallax is known, the distance of the earth, and of all the planets, from the Sun, will be known likewise."

OBSERVATIONS of the TRANSIT OF VENUS over the SUN, and the ECLIPSE of the SUN, on June 3d, 1769. Made at the ROYAL OBSERVATORY, GREENWICH. By the Revd. NEVIL MASKELYNE, B. D. F. R. S. and Astronomer Royal.

Communicated to the Society, By Dr. SMITH, and ordered to be published, at a Meeting, May 18th, 1770.

THE weather, which had been cloudy or rainy here, with a south wind, for the greatest part of the day, began to clear up at 4 o'clock in the afternoon, the wind having returned to the west, the same quarter in which it had been the afternoon before, which was remarkably fine and serene, though it changed early in the morning preceding the transit. Towards the approach of Venus's ingress on the Sun, the sky was become again very serene, and so continued all the evening, which afforded as favourable an observation of the transit here as could well be expected, considering that the Sun was only $7^{\circ}. 3'$ high at the external, and $4^{\circ}. 33'$ at the internal contact. I observed the external contact of Venus at $7^h. 10'. 58''$ apparent time, with an uncertainty seemingly not exceeding

exceeding $5''$; and the internal contact, by which I mean the completion of the thread of light between the circumferences of the Sun and Venus, at $7^h. 29'. 23''$ apparent time, with a seeming uncertainty of only $3''$; for so long was the thread of light in forming, or the Sun's light in flowing round and filling up that part of his circumference, which was obscured by Venus's exterior limb. Nevertheless, I would not hence infer, that observations made by astronomers in distant places should agree together within such narrow limits; for I know they will not even in the same place, and that a difference in the skill or judgment of the observers, in the telescopes, and perhaps in some other little circumstances, not easily distinguished, may produce much greater disagreements, especially if the Sun be low, as it was here; in like manner as in observing the eclipses of Jupiter's satellites, the immersion or emersion shall often seem instantaneous, or nearly so, equally to two observers in distant places, and yet the absolute times of the observations may differ a minute of time or more from each other, owing to the difference of telescopes, weather, or other circumstances. Indeed, in the present case, the limit of differences is certainly much narrower; but what it is I shall not at present venture to suggest, as that may better be done, when all the observations that shall have been made of the transit are collected together. The telescope which I used was an excellent reflecting one of two feet focus, made by the late ingenious Mr. Short, and is the same with which the last transit was observed here by Mr. Charles Green. I applied the magnifying power of 140 times, and used smoked glasses to defend the sight, which are much preferable to black or red glasses, as shewing the objects more distinct, and being much more pleasant to the eye.

I SHALL now endeavour to describe, as accurately as I can, some other phænomena which I noted during the immersion of Venus, and to mention some others, which by some ingenious persons were expected to have been seen, but which I could not discover.

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It had been thought by some, that Venus's circumference might probably be seen, in part at least, before she entered at all upon the Sun, by means of the illumination of her atmosphere by the Sun; I therefore looked out diligently for such an appearance, but could see no such thing.

I was also attentive to see if any penumbra or dusky shade preceded Venus's first impression on the Sun at the external contact, such a phenomenon having been observed by the Rev. Mr. Hirst, F. R. S. at the former transit of Venus, in 1761, which he observed with much care and diligence at Madrafs, in the East-Indies; but I could not discern the least appearance of that kind. I would not, however, be therefore thought to call in question either Mr. Hirst's discernment or fidelity; as I am sensible that the tremors of the limbs of the Sun and Venus, occasioned by the vapours at the altitude of 7° , might easily obscure a faint object.

When Venus was a little more than half immersed into the Sun's disc, I saw her whole circumference completed, by means of a vivid, but narrow and ill-defined border of light, which illumined that part of her circumference which was off the Sun, and would otherwise have been invisible. This I might, probably, have seen sooner, if I had attended to it. I continued to see it till within a few minutes of the internal contact, and grew apprehensive that it would prevent the appearance of the thread of light, when it came to be formed; but it disappeared about two or three minutes before, as well as I can remember: after which the regularity of Venus's circular figure was disturbed towards the place where the internal contact should happen, by the addition of a protuberance, dark like Venus, and projecting outwards, which occupied a space upon the Sun's circumference, which bore a considerable proportion to the diameter of Venus. Fifty-two seconds before the thread of light was formed, Venus's regular circumference, supposed to be continued as it would have been without the protuberance, seemed to be in contact with the Sun's circumference supposed also completed. Accordingly, from this time, Venus's regular circumference, supposed defined in the manner
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just described, appeared wholly within the Sun's circumference; and it seemed, therefore, wonderful that the thread of light should be so long before it appeared, the protuberance appearing in its stead.

At length, when a considerable part of the Sun's circumference, equal to one third or one fourth of the diameter of Venus, remained still obscured by the protuberance, a fine stream of light flowed gently round it from each side, and completed the same in the space of three seconds of time, from $7^h.29'.20''$ to $7^h.29'.23''$ apparent time; and Venus appeared wholly within the Sun's lucid circumference; but the protuberance, though diminished, was not taken away till about $20''$ more, when, after being gradually reduced, it disappeared, and Venus's circular figure was restored.

An ingenious gentleman of my acquaintance having desired me to examine if there was any protuberance of the Sun's circumference about the point of the internal contact, as he supposed such an appearance ought to arise from the refraction of the Sun's rays through Venus's atmosphere, if she had one; I carefully looked out for such a circumstance, but could see no such thing; neither could I see any ring of light round Venus, a little after she was got wholly within the Sun: but, I confess, I did not re-examine this latter point afterwards, when she was further advanced upon the Sun, at which time other persons at the observatory saw such an appearance.

How far the ring of light, which I saw round that part of Venus's circumference which was off the Sun, during the immersion, may deserve to be considered as an indication of an atmosphere about Venus, I shall not at present inquire; but I think it very probable, that the protuberance, which disturbed Venus's circular figure at the internal contact, was owing to the enlargement of the diameter of the Sun, and the contraction of that of Venus, produced by the irregular refraction of the rays of light through our atmosphere, and the consequent undulation of the limbs of the two planets; the altitude of Venus being only $4^\circ.48'$, though the Sun's limb was more distinct

distinct and steady than usual at that altitude. This conjecture seems corroborated by two circumstances: one is, that Venus's limb, from its first appearance to the total immersion, as well as afterwards, was very ill defined, and undulated very much; the other is, that her horizontal diameter, which I measured soon after the internal contact with an excellent achromatic object-glass micrometer, fitted to the two-feet reflecting telescope, was only fifty-five and three fourths of a second, by a mean of eight trials, or about $3''$ less than it should have been, from the observations made, with the like instrument, at the transit of Venus in 1761, by Mr. Short, Mr. Canton, Mr. Haydon, and Mr. Mason, when the Sun was at a considerable altitude; and most likely the Sun's diameter was enlarged in proportion, though it might have been difficult to have ascertained it by actual measure, had time allowed me to make the experiment with the same micrometer before the Sun entered into a black cloud near the horizon.

Six other persons also observed the contacts of Venus here, and noted some other phenomena. Their names are, the Rev. Malachy Hitchins, a gentleman well acquainted with astronomy and astronomical calculations, who has made and examined many belonging to the Nautical Almanac, and has been so obliging as to come here and assist me in making astronomical observations, during the absence of my assistant, Mr. William Bayley, who is gone to the North Cape, by appointment of the Royal Society, to observe the transit of Venus there. The others are, the Rev. William Hirst, who observed the former transit of Venus, in 1761, at Madras; John Horsley, Esq; a gentleman whom I had the pleasure of first commencing an acquaintance with during my voyage from St. Helena to England, in the Warwick East-India ship, and who then, and in several voyages since to the East-Indies and home again, observed and calculated the longitude from distances of the Moon from the Sun and fixed stars with the greatest accuracy; Mr. Samuel Dunn, who has had a good deal of practice in making astronomical observations, and who carefully observed the former transit of Venus, in 1761, at Chelsea; Mr. Peter Dollond, whose great skill in constructing

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achromatic and reflecting telescopes ; and Mr. Edward Nairne, whose skill likewise in the same way, and in making all kinds of mathematical and philosophical instruments, are sufficiently known to the public.

Mr. Horsley and Mr. Dunn observed with me in the great room ; Mr. Hitchins and Mr. Hirst in the eastern summer-house ; and Mr. Dollond and Mr. Nairne in the western summer-house ; by three clocks placed in the respective rooms, which were compared with the clock in the transit room, before the external contact, and again after the internal contact was past ; whence the times of the observations, as noted by the clocks, were reduced to the time of the transit clock, and thence to apparent time.

THEIR observations, together with my own, are given in the following table, as reduced to apparent time.

	External contact.	Regular circum- ferences in con- tact.	Thread of light com- pleted, or, the internal contact.	Telescopes made use of.	Magni- fying power.
	h. m. s.	h. m. s.	h. m. s.		
N. Maskelyne	7 10 58	7 28 31	7 29 23	2 feet reflector.	140
M. Hitchins	7 10 54	7 28 47	7 28 57	6 feet reflector.	90
W. Hirst	7 11 11	-----	7 29 18	2 feet reflector.	55
J. Horsley	7 10 44	7 28 15	7 29 28	10 feet achromatic.	50
S. Dunn	7 10 37	7 29 28	7 29 48	3½ feet achromatic.	140
P. Dollond	7 11 19	-----	7 29 20	3½ feet achromatic.	150
E. Nairne	7 11 30	-----	7 29 20	2 feet reflector.	120

Mr. Dollond and Mr. Nairne used telescopes of their own construction ; but they did not wait till the thread of light was formed at the internal contact, but noted the time, when they judged it was just ready to be formed. The three and an half feet achromatic telescopes were those made with three object-glasses.

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THE differences between the different observations seem pretty considerable, and greater than I expected, considering that all the telescopes may be reckoned pretty nearly equal, excepting the six feet reflector, which is much superior to them all; and to its greater excellence and distinctness I principally attribute the difference of $26''$, by which Mr. Hitchins saw the internal contact before me; as I can depend upon his observations. Possibly the greatness of the differences might arise from the low altitude of the Sun and Venus; and then the like differences would not be so much to be feared in places where the observation may be made at higher altitudes; otherwise the Sun's parallax will not be decucible from the transit of Venus with that accuracy which has been expected.

THE other appearances about Venus, noted by the six observers, which they have communicated to me are as follows:

MR. Hitchins remarks, that, at the first contact, though there was a tremulous motion in the Sun's limb, yet that part of it which the planet entered was very well defined, and the first impression of Venus appeared to be instantaneous, and as a black, sharp point. At the internal coincidence of circumferences, the fluctuation of the Sun's limb was increased, and the limb of Venus being affected in like manner, there was an uncertainty of about $10''$ in estimating the said coincidence; but at the breaking in of the thread of light between the limbs, there was not a greater uncertainty than a second and a half of time. At the internal coincidence of circumferences, the limb of Venus next to that of the Sun being protuberant, her vertical diameter appeared to be longer than the horizontal one; but when the Sun approached the horizon, and was scarce above a degree high, Venus's horizontal diameter appeared to be sensibly longer than the vertical, which was, probably, owing to refraction. After the internal contact, there appeared a luminous ring round the body of Venus, about the thickness of half her semi-diameter; it was brightest towards Venus's body, and gradually diminished in splendor at greater distances, but the whole was excessive white and faint. This radiancy round the planet seemed to him to be greater in Mr. Nairne's two feet telescope than in the six feet Newtonian reflector.

AFTER the second or internal contact, Mr. Hirst left off observing with Mr. Dunn's two feet reflector, and had a sight of Venus in the six feet Newtonian reflector, in which he thought he perceived a glimmering of light about the upper part of the circumference of Venus, or that part of the planet which entered last into the solar disc.

AFTER Venus was got within the Sun's disc, a light a little weaker than that of the Sun, of a purplish colour, appeared to Mr. Horsley, to the left hand of Venus, which is really to the right, the telescope inverting objects. This light he saw for six or seven minutes.

FROM $7^h 28' 26''$ to $7^h 28' 30''$ apparent time, Mr. Dunn saw a very faint rim of light at Venus's exterior limb. After Venus was wholly on the Sun, he saw a faint ring of light surrounding her, both with the three and a half feet telescope, and Mr. Nairne's two feet reflector.

WHEN one third of Venus's diameter was entered upon the Sun, Mr. Dollond first saw a light about the exterior limb of the planet: this light, during all the time of its continuance, appeared rather reddish, and in all respects like irregular refracted light. After Venus was wholly entered upon the Sun, he saw a faint ring surrounding her.

AFTER Venus was wholly entered upon the Sun, and her exterior limb was near one of her semi-diameters distant from the Sun's circumference, Mr. Nairne saw a faint light round the planet, rather brighter and whiter than the body of the Sun.

FORTUNATELY, the weather was as favourable for the observation of the eclipse of the Sun, the next morning, as it had been the evening before for that of the ingress of Venus upon the Sun; which is of the more consequence, as the comparison of it with the observations which may be made of it in the northern and eastern parts of the world, will serve to settle the longitudes.

longitudes of those places, and consequently render the observations which may be made there of the transit more useful and valuable.

I OBSERVED the beginning of the eclipse at $18^h. 38'. 54''$, and the end at $20^h. 23'. 30''$ apparent time, with the 2 feet reflector, using the magnifying power 90 times. And at $19^h. 29'. 31''$ apparent time, I observed the greatest eclipse, at which time I found the remaining lucid parts of the Sun $15'. 15''$, with Dollond's micrometer, assuming the horizontal diameter of the Sun $31'. 31''$, whence the value of the scale of the micrometer was determined for the present purpose. Hence the eclipsed parts of the Sun were $16'. 16''$, or 6 dig. $11', 62$ on the northern part of his disc.

MR. Hitchins observed the beginning of the eclipse with a three and an half feet achromatic telescope magnifying 150 times (the same with which Mr. Dollond observed the contacts of Venus), at $18^h. 38'. 59''$, and the end of the eclipse with the 6 feet reflector with the magnifying power 90, at $20^h. 23'. 35''$ apparent time. And Mr. Samuel Dunn observed the beginning of the eclipse at $18^h. 39'. 9''$, and the end at $20^h. 23'. 33''$ with the other three and an half feet achromatic telescope, magnifying 140 times, the same with which he observed the contacts of Venus. Several inequalities in the Moon's circumference, seen upon the Sun's disc during the eclipse, were distinctly discerned by all of us, the air being very clear, and the objects steady.

THE whole series of measures of the lucid parts, which I took with the achromatic object glass micrometer applied to the 2 feet telescope, was as follows.

Apparent time.			Lucid parts.	
h.	'	"	'	"
19	22	13	15	40,5
	24	21	15	26,5
	26	9	15	20,9
	28	26	15	15,6
	30	14	15	14,5
	31	44	15	16,4
	32	30	15	16,4
	33	19	15	19,8
	34	28	15	25,4
	36	19	15	35,9
	37	56	15	49,1

Some ACCOUNT of the TRANSIT of VENUS, and ECLIPSE of the SUN, as observed at the LIZARD POINT, June 3d, 1769. By Mr. JOHN BRADLEY.

MR. MASKELYNE, the Astronomer Royal, who has drawn up this short account, mentions that having had some doubts that neither the latitude nor longitude of the LIZARD-POINT were duly fixed, " he had proposed those doubts to the Board of Longitude, who being sensible of the importance of determining the position of a place of so much consequence in the British navigation, resolved that proper astronomical observations should be made at the LIZARD for that purpose; and the *Transit of Venus* appeared a convenient opportunity, itself affording one of the best means of determining the longitude of places; and the *Eclipse of the Sun* which was to happen the morning after, affording another of determining the same.

" ACCORDINGLY Mr. JOHN BRADLEY, nephew of the late Dr. BRADLEY, and formerly his assistant at the Royal Observatory, was appointed to make these observations. The instruments which he was provided with, were an equal-altitude and transit instrument in one, an astronomical quadrant, and a reflecting telescope of two feet focus, all made by Mr. BIRD; and an astronomical clock, with a gridiron pendulum, made by Mr. SHELTON.

" Mr. Bradley staid at the LIZARD 51 days, viz. from May 13th to July 3d, during which time he was lucky enough to make a great many useful observations; some of the principal of which were the following, viz.---

SEVERAL meridian altitudes of the sun and pole star; by which the *latitude* of LIZARD-POINT was determined to be $49^{\circ}. 57'. 30''$. N.

The

The Transit of VENUS and Eclipse of the SUN, viz.---

1769 Apparent time.

June 3d. 6^h. 50'. 7", 4 External contact of VENUS and the SUN, very exact the eye being fixed on the place.

7. 8. 25. Internal contact; doubtful to 4 or 5", a cloud having hid *Venus* so long; and at the cloud's going off, 2" after the time set down, a thread of light appeared very distinct between the circumferences of the Sun and Venus.

18. 14. 54. Begin. of the Eclipse of the Sun } Both
19. 57. 17 End of the Eclipse. } very good

" THESE observations were made with the 2 f. reflector, and the magnifying power 120.

D. h. min. sec.
June 8. 9. 20. 14 Em. 1st sat. of Jupiter. Jupiter had not been from under the clouds 10" when he saw the satellite, yet he reckons the observation good.

June 15. 11. 13. 46 Em. 1st. sat. A thin haze about Jupiter, but the observation pretty good. These emersions were observed with the same telescope, but with the magnifying power 100.

COMPARING the observation of the CONTACTS of *Venus* at the LIZARD with his own at GREENWICH, making a small allowance for the difference arising from the effect of parallax at the two places, Mr. MASKELYNE makes the difference of meridians of GREENWICH and the LIZARD----

By the external contact of VENUS	20'. 53".	} of time.
By the internal contact of ditto	21. 01	
The mean by the contacts	20. 57	

By

By the two emerfions, making a small allowance for the difference of brightness of the telescopes, he makes the difference of meridians as follows, viz.

By the first emerfion	-	-	-	21'. 07"
By the second emerfion	-	-	-	21. 52
The mean of these is	-	-	-	21. 29,5
The mean by the contacts	-	-	-	20. 57
Mean of the two means	-	-	-	21. 13,25

BUT Mr. Maskelyne, till he has time to compare the other observations, fixes on 21'. 0" of time = $5^{\circ}. 15'$ of the equator, for the difference of longitude of the LIZARD west of GREENWICH.

THE above is taken from the nautical almanac for 1770; and it was thought might be a proper addition to the foregoing account of the Transit of Venus, at Greenwich, drawn up by the Astronomer Royal.

The Reader is desired to correct the following ERRATA in some of the foregoing Sheets :

- Pag. 53---for 4h. 26'. 31", in the col. of Apparent Time, *read* 5h. 26'. 31".
 Pag. 60, the sixth line from the bottom, for 2,3922, &c. *read* 2'.392375.
 Pag. 61, for 17'.336. *read* 17'.356.
 Pag. 67, for 3'. 31" E. in the col. of longitude of Sav. House, *read* 0'. 31" W.
 Pag. 79, l. 25, for so is its Rad. S, 242".936, *read* is to R. so is S, 242".936.
 Pag. 80, l. 12, for her from the Earth, *read* her distance from the Earth.
 Pag. 81, l. 14, for et, *read* at; and line 26, for Sun, *read* Earth.

[81]

TRANSACTIONS

O F T H E

American PHILOSOPHICAL SOCIETY.

SECT. II.

ESSAYS ON AGRICULTURE.

An ESSAY on the cultivation of the VINE, and the making and preserving of Wine, suited to the different Climates in *North-America*. By the Hon. EDWARD ANTILL, Esq; of *New-Jersey*. Communicated to the Society

By CHARLES THOMSON, with the following
Extract of a Letter to him.

DEAR SIR,

I HAVE at last, after many hard struggles, and many a painful hour, labouring under a tedious disorder, finished the essay on the cultivation of the Vine, &c. which I now send you.

Nothing but the love of my country and the good of mankind could have tempted me to appear and expose myself to public view. I have, to the utmost of my skill and knowledge, endeavoured to lay open and explain every part of this undertaking, yet new to America; though an undertaking as antient at least as the days of Noah; and yet what seems strange to tell, it is an art that has not yet arrived at perfection, but is still visibly capable of some essential improvements: That America should give the finishing stroke at last to a
Q work,

work, that has been in hand above four thousand years; and what is still more strange, a work every part of which, is an experiment, if attended to; I say that the compleating of such a work should be left to the genius of America, no doubt would give the people of America a good deal of pleasure. That this will be the case, I cannot yet take upon me to say; but I think there are some hints now offered, which if steadily pursued, and improved by easy experiments, the making of wines and the preserving them, will soon arrive at greater perfection, than yet it has been done.

The Success and perfection of every undertaking depends upon setting out right: Indeed the people of America have greatly the advantage of the people of Europe, in things of this nature, because we begin where they leave off, and we are free from the force of all their prejudices and erroneous customs; but then we must determinately act like men, and judge for ourselves, and not implicitly follow them, without the use of our own reason: Let us then suppose that every art is capable of improvement, and let the people of America try the strength of their own genius. They may hit on things, that have not been thought of before; for we yearly see, that the arts and sciences too meet with constant additional improvements; and why should the people of America be secluded from the honour and pleasure of being servicable to mankind in their turn. We must expect to meet with all the discouragements, that the artifice of France, Spain and Portugal can give us; we shall be told, that our country is too new, our soil is not fit, and our climate is the reverse of that of wine countries; besides that without the help of experienced vignerons it will be impossible for us to make any hand of it; that as to books, they are so erroneous, that there is no dependence upon them, and abundance of such stuff. But let not the people of America be dupes to France, or any set of designing men.

Why the people of America, that trade in Wines, should give opposition to the undertaking, I cannot conceive. They and their children will be dead and gone, before it can arrive to such a pitch, as to interrupt their trade; besides it must, when brought to perfection, be a double advantage to such men; for it is well known, that the wine merchants, in all wine countries, gain more by Wine, than the people that make it; and their gain will still be encreased, when they come to send it home to the mother country.

The

The papers I send you are only a rough draught, as you will easily discover; I have not strength to go over it again, to range all the parts under different heads, in order to reduce them to proper chapters for the ease of the reader; I must leave that to the printer, and to those that direct the press.

I am, &c.

Monmouth, New-Jersey,
Shrewsbury, May 10, 1769.

E. A.

An Essay on the CULTIVATION of the VINE, &c.

THE VINE, if considered in its full extent of pleasure, profit and usefulness to Man, challenges, next to what affords us Bread, the chief place among the vegetable creation; its fruit, when thoroughly ripe, is pleasing to the eye, grateful to the taste, comforting to the stomach, refreshing to the body when eaten with caution and moderation, and greatly contributes to health. Its juices, when express'd and rightly fermented and purified according to art, partake of a noble spirit truly homogeneous and fit for the use of Man. They gladden his heart, remove to a distance his troubles and cares, cause him to forget his poverty and low estate, and raise him to a level with the rich and great: They enliven his thoughts, exhilarate his spirits, cheer his soul, and for a time make him as happy as his present condition is capable of. Wise and happy is the man, that shuns excess, that prudently avoids turning this cordial into a cup of poison, and moderately enjoys the blessing with a thankful heart.

Introduc-
tion.

WINE is a very considerable branch of trade. The many advantages that must arise to the Colonies from the making it, as well as to the Mother Country, are so great and so very well known, that I need not go about to describe them at large; to touch upon them is sufficient.

THE planting of Vineyards, the cultivation of Vines, the making of Wine, and Casks to preserve it, must employ and give bread to a great number of people; the freight and a pro-

fitable remittance, must enrich the merchant; and the being supplied from the colonies with wine, in exchange for her manufactures, must be a considerable saving to Great-Britain.

I know full well, that this undertaking being new to my countrymen, the people of America, will meet with many discouraging fears and apprehensions, lest it may not succeed. The fear of being pointed at or ridiculed, will hinder many: The apprehension of being at a certain expence, without the experience of a certain return, will hinder more from making the attempt; but let not these thoughts trouble you, nor make you afraid. You have a friend for your guide, who will not deceive you, nor mislead you: One, who by experience, knows, that the thing is practicable here, where the country is open and clear; one who looks upon you all as his children, and with the fondness of an affectionate father will take you by the hand, and lead you with plainness and honest simplicity, through all the different operations, till you become masters of the whole, and then with pleasure and delight will look on and see you reap the profits, to your full satisfaction, of all your expence and labour.

WHOEVER considers the general climate of North-America, the soil, the seasons, the serenity and dryness of the air, the length and intenseness of the heat, the fair and moderate weather, that generally prevails in the fall, when Grapes are coming to maturity, and arrive at their greatest perfection; whoever compares the present state of the air, with what it was formerly, before the country was opened, cleared and drained, will find that, we are every year fast advancing to that pure and perfect temperament of air, fit for making the best and richest Wines of every kind.

Such has been the bounty and goodness of Heaven, that there are Vines adapted to every country, to every region, from fifty degrees both north and south latitude down to the Equator; and the countries beyond these may easily be supplied by traffic, so that all the sons of men may partake of this general, this universal blessing.

It

It is not every Vine, that is fit for every country : Some are earlier, some are later ripe ; some are tender and delicate, and will not stand the severity of winter, others are hardy and robust, and will stand any weather : Hereafter I shall range them in proper and distinct classes, and adapt the different sorts by name to the different climates in America, where they may be propagated with safety and to the best advantage.

A VINE, from a stick or cutting, begins to bear fruit the third year, the fourth year it bears more, and the fifth year you may make Wine ; and for your greater encouragement, from that time until it attains the full age of man, it increases in value and yields a richer Wine ; and if from the beginning, it be carefully pruned, duly manured and properly cultivated, it will generously reward you for all your labour, expence and care, and will hold good above an hundred years, as most writers affirm. But then it must be tended by a careful and steady hand. I will not bear to be slighted, or neglected. If you do not manure the ground and keep it in good heart, your Vine will bear no fruit ; if you neglect to cultivate the soil and keep it clean, your fruit will be knotty, and starved, and will not come to maturity ; if you suffer the stakes or props to fall, and your Vine to sprawl on the ground, the fruit will not ripen, but remain austere, and will not make good Wine. Wine is too rich a juice to be made from a barren soil, or by lazy idle slovens. Such men should never undertake a Vineyard. They not only hurt themselves, and bring the thing into discredit, but hinder others, who are fit for the undertaking, from making the attempt. If a Vineyard does not succeed, the fault is in the man, not in the Vine. It will flourish and prosper under a careful diligent hand ; but it will degenerate and run wild under the hand of sloth and idleness. A gentleman of Rome, who took great delight in Vineyards, some of which he had raised with his own hands, wrote a very elegant piece upon the culture of Vines, and in the most pathetic terms recommends it to the people of Italy, as the most profitable, as well as agreeable amusing undertaking. Among many other encouragements, he tells them this story : “ Pavidus Veterensis, a neighbour of my uncle, had

had a Vineyard and two daughters. Upon the marriage of one of them, he gave with her as her dowry, one third of his Vineyard; and then doubled his diligence, and cultivated the remainder so well, that it yielded him as much as the whole had done before: Upon the marriage of the other daughter, he gave with her one other third of his Vineyard; and now having but one third part of the whole left, he so manured and cultivated it, that it yielded him full as much as the whole had done at first."

THIS ingenious author accuses many of his countrymen of having begun this work with seeming resolution, and of having carried it on for some time with assiduity, but before they had brought it to perfection, they flagged, and for want of steadiness and a little longer perseverance, lost their money, their labour, and all their prospects. At the same time he proves to a demonstration, from exact and minute calculations, the great advantages of Vineyards, notwithstanding the great expence the Romans were at in buildings, inclosures, workmen and magnificent works, and brings his own Vineyards, which were well known, as proofs of all he had said.

I SHALL take the liberty to conclude this introduction with a short but pretty description of the Vine, which Cicero, in his beautiful tract upon old age, puts into the mouth of Cato.

THE Vine that naturally runs low, and cannot rear itself without a support, is for this end provided with tendrils, by which, like so many hands, it lays hold on every thing it meets with, that may raise it, and by these aids it expands, and becomes so luxuriant, that to prevent its running out into useless wood, the dresser is obliged to prune off its superfluous wandering branches; after which from the standing joints, in the ensuing spring, the little bud called the gem, pushes out the new shoot, whereon the tender young Grape is formed; which, gradually swelling by nourishment from the earth, is at first austere to the taste, but guarded with leaves around, that it may neither want due warmth, nor suffer by too scorching rays, it ripens by the Sun's enlivening beams, and acquires that delicious

licious sweetness and beautiful form, that equally please both the taste and eye; and then enriches the world with that noble liquor, the advantages of which I need not name. Yet it is not the sense of these, nor of all the advantages of husbandry, that so nearly affect us, as the pleasure I find in their culture alone; such as ranging the Vines and their supporting perches in exact and even rows, in arching and binding their tops, lopping off the woody and barren, and training the fruitful branches to supply every vacancy, and then contemplating the beauty and order with the process of nature in the whole.

Of the planting and management of the Vine.

THE first thing necessary to a good Vineyard is a proper plot or piece of ground. Its situation should be high and dry, free from springs and a wet spewy soil. Its aspect or front should be toward the south and south-east. Though the ground be not a hill, yet if be high, open and airy, and gradually ascends towards the south or south-east, it will do very well. If it be a fruitful hill, it will do better. But if it be a mountain, with a rich soil, it will be best of all; for the higher the Vineyard, the richer the Wine.

The proper soil for a vineyard.

THE soil most natural to a Vineyard, and such as produces the sweetest Grapes, and the richest strongest Wine, is a rich mould mixed with sand. The newer and fresher the ground, the better; such a soil may be found on a rising ground and on some hills, but very seldom on the sides of mountains; for here the soil is generally stiff and clayey, so ordered by Providence, as being less subject to be washed away by hard rains; but this stiff soil on the side of mountains, differs greatly from clay grounds below; the winds and air, and the Sun's heat so dry and warm it, that it becomes a proper bed for Vines, and renders them both prolific and productive of the richest Wines.

A RICH warm soil mixed with gravel, or a sandy mould interspersed with large stones, or with small loose rocks, are also very proper for a Vineyard. Rocks and stones, if the soil be good, warm and dry, are no disadvantage to Vines. On the contrary,

contrary they reflect great heat to the fruit, and thereby contribute towards perfecting the Wine, especially if they are on rising ground, on the declivity of a hill, or on the side of a mountain. It is true, they are attended with some inconveniences. It is more difficult to keep such a Vineyard clean, to stake it well, to range the Vines in proper order, and regular form, to dung the ground, and to gather in the Vintage. But, then, these rocks and stones will make a good, close, strong and lasting fence. On the sides of hills and mountains they are absolute necessary to make low rough walls along the lower side of the Vines, to preserve the good soil from washing away. They serve also to keep the ground moist in hot dry times, when, but for them, the soil would be parch'd up along such steep grounds. In short, there would be no such thing as raising Vineyards on such grounds, were it not for rocks and stones. For as it is necessary to keep the soil loose and mellow, it would all wash away with hard rains, if not prevented by forming a kind of rough wall of stones along the lower side of each row of Vines. Again, such lands are cheap, being unfit for other purposes and generally yielding little timber or grafs. They may therefore be purchased by poor people, who could not afford to go to the price of good land. Lastly, these steep hills and mountains always yield the richest Wines, the value and price of which will compensate for any extraordinary labour.

The
ground to
be ma-
nured.

If the ground be worn and out of heart, it must be renewed, and helped with dung, with fresh mould, with creek mud, with the rich soil, that lodges along the sides of brooks or rivers, or that settles in low places at the foot of hills or mountains, or by foddering cattle and sheep upon it with good store of straw, salt hay, or corn-stalks, &c. or by penning such cattle upon it and ploughing all under as deep as may be, till all be made sufficiently rich, or by any other method, that shall best suit the owner.

If your ground be stiff, it may be mended by good store of sand, ashes, soot, the rubbish and mortar of old buildings, well pounded, especially if such mortar be made of lime

lime and sand, by the dust and small coal of coal kilns, and the earth, that they are covered with when they are burnt, sea sand or fine gravel, and good store of fowl's dung and sheep's dung, or the old dung of neat cattle.

AFTER your ground is brought into good heart, and has been deep ploughed or dug and well harrowed, so as to be quite mellow, it must be well secured with a good close fence, such as is fit to turn rambling boys, as well as cattle and hogs, for on this depends the success of the whole. And well fenced;

THE next step to be taken, is to provide a sufficient stock of Vine Cuttings, not only enough to plant the Vineyard, but a small nursery too. If these cannot be had all at once, begin to lay up a year or two beforehand, and plant them in your nursery in even rows, at four inches distance, and the rows three feet asunder, that they may be howed and kept clean; and scatter some short straw and chaff along between the rows to keep the ground moist and the weeds down. Let the ground of your nursery be in good heart, but by no means so rich, as the soil of your Vineyard; if it is, when the plants are removed into the Vineyard, they will pine and dwindle, and seldom flourish and become fruitful. The reason of planting the cuttings so close in the nursery is, to prevent their shooting their roots too far into the ground, which would render them very difficult to take up without damaging the root, and more tedious to plant out. Method of planting a nursery.

BE not over fond of planting various sorts of Vines in your Vineyard, if you mean to make good Wine. The most experienced Vignerons say, that Grapes of one sort make the best Wine; that if they are mixed, they hurt the Wine, by keeping it constantly upon the fret, by means of their different fermentations. Be that as it may, I should recommend this practice for reasons, that operate more strongly with me, which are, that the more simple and pure Wine is, the more perfect it is in kind. Three different Wines may be all good in kind and very agreeable, whilst distinct, but when mixed together become quite the reverse, and the whole is spoiled. If my AVineyard should not have too many sorts of Vines.

Vineyard contained one-acre of ground, I should choose to have but two sorts of Grapes in it, if I meant to make a profit of it by selling the Wine; if it contained two acres, I would have four sorts in it; and if it contained three or four acres, I should not choose more. But if it contained six, eight or ten acres, perhaps I might incline to have a greater variety; but then I should prefer those kinds that make the best Wines and such as do not come in at the same time, from whence I should reap many advantages. First I should not be overhurried in the time of Vintage, nor run the risque of having some spoil upon my hands, whilst I was making up the rest; again, if a season proved unfavourable, and some were cut off by the inclemency of the weather, others, that were later ripe, might escape the injury. It is certainly best to plant each sort in a distinct quarter by itself, if we mean to avoid confusion, and to reap every advantage.

The Vines
suitable to
the differ-
ent cli-
mates in
North-
America.

THE next thing to be considered is the quality of the Vines to be made choice of. This must be limited, and adapted to the climate, where the Vineyard is planted. The most hardy and earliest ripe, will best suit the most northern colonies, I mean those of New-Hampshire, Boston, Rhode-Island and Connecticut. As to those countries, that lie still farther north, they are not yet sufficiently cleared and open for the purpose. The Vines proper for these countries are,

- | | | |
|------------------------|--|----------------------|
| 1. The black Auvernat, | These first 4 num-
bered make the
best Burgundy. | The white Muscadine, |
| 2. The black Orleans, | | The Muscadella, |
| 3. The blue Cluster, | | The Melie Blanc, |
| 4. The Miller Grape, | | The white Morillon, |
| The black Hamburgh, | | The white Auvernat, |
| The red Hamburgh, | | The grey Auvernat. |

ALL these are ripe early in September.

ALL the foregoing sorts will do very well for the three bread colonies, viz. New-York, New-Jersey, Pennsylvania, and the three lower Counties; I mean for the clear and open parts of these countries; to which may be added the following sorts, which

which I recommend by way of tryal, they being more tender, but ripen in September; they should have the warmest birth in the Vineyard.

The Chaffelas Blanc, called	The red Frontiniac,
the Royal Muscadine,	The black Lisbon,
The Malvois or Malmsey,	The white Lisbon,
The grey Frontiniac,	The Chaffelas Noir.

ALL the foregoing sorts will do very well for the colonies of Maryland, Virginia, and North-Carolina, to which I shall add the following sorts, and recommend them for tryal, but then they must have a warm place.

The white Frontiniac,	The black Damask,
The malmsey Muscat,	The Chicanti of Italy, which
The claret Grape of Burdeaux,	makes a rich Wine much
The white Oporto,	admired in Italy.
The black Oporto,	

ALL the abovementioned sorts will do well in South-Carolina, and in the colonies still farther south. To which I shall add the following sorts, as being still more tender and later ripe.

The raisin Muscat,	The white Muscat of Alexan-
The Alicant and Malaga	dria,
Raisin Grape,	The gros Noir of Spain,
The red Muscat of Alexan-	The St. Peter's Grape.
dria,	

In many parts of Virginia, North and South-Carolina, and in Georgia, the soil is chiefly a hot dry sand, and what strength nature afforded has been exhausted by tobacco, Indian corn, rice, &c. However these grounds, where they lie near to rivers and creeks, may easily be recruited; for these rivers abound with rich mud, which is the best kind of manure for such lands, and it would be no great expence to procure a sufficient quantity of it to cover a piece of ground large enough for a Vineyard, especially if it be considered, what a number of

hands the gentlemen of these countries have, who might be employed at such times, when other business is not very urgent : But then this mud must lie some time upon the ground, before it be mixed with the soil, at least a summer and a winter ; for at first it will bake very hard, and be very crude ; but the winds, dews, rains and frosts, with the help of the Sun, will sweeten, mellow, and bring it into a proper temper. Then it must be equally spread and well mixed with the soil. Thus may the land be recruited, and kept in good heart, from time to time, and from a barren useless piece of ground, it may become profitable both to the owner and his country.

The parts
of a Vine
proper for
cuttings
to plant.

THE nature and quality of the vines being considered and made choice of to suit the country you live in, the next thing necessary to be known is, how to make choice of such parts of a Vine, for cuttings to plant, as may be most likely to grow and flourish, and also to produce healthy and fruitful Vines, on which the success and profits of a Vineyard very much depend. Know then, that all parts of a Vine are not equally good and fit for plants. If you have it in your choice, avoid all branches, that have not born fruit, all suckers, nephews, lateral and secondary branches, and especially the long running barren branches. These different sorts seldom produce fruitful Vines. Choose, therefore, your cuttings from the teeming part of the Vine, from among those branches that were set apart for bearing fruit ; and among these, choose such as are short jointed, and have been most fruitful the last summer, so shall you be sure to have fruitful and thrifty Vines. Let them be cut down close to the old wood ; for here the wood is ripest and most firm. The upper part of the same branch is less ripe, and more loose and spongy, and more apt to fail, and very seldom makes so firm and lasting a Vine. However, where Vines are scarce, and men have not these advantages in their power, they must do the best they can. These branches must be trimmed and cleared from the nephews and the lateral or secondary branches ; but in doing this, great care must be taken not to wound the buds or eyes, which a careless hand is very apt to do. If the bud be bruised with the back of the knife, so that the cotton, that lies under the
thin

thin bark, that covers the bud, and is wisely intended to preserve it from the injuries of the weather, be rubbed off, the bud will perish. Therefore as the buds lie close to these lateral branches, and are in so much danger of being wounded, it is best and safest to cut the branches off, a little above the height of the bud, that the little stump or stub left behind may be above the top of the bud, so shall the eye be left secure, and run no risque of being blinded.

THESE branches being thus trimmed remain whole and at full length 'till the next April, which in the northern colonies, is the best time for planting. They should be separated from the mother plant, sometime in September, or as soon as the Vintage is over, that being the best time for the trimming of Vines, because the wounds which the mothers receive are healed up, and securely closed from the severity of the winter season. If this work be left 'till February or March, the parent suffers by her fresh wounds, in long rains, fleets and frosts that follow; or if the weather be favourable, she grows faint and exhausted by excess of bleeding, and her eyes are drowned in her own blood.

The time
to procure
cuttings.

THE best way I have found for preserving the cuttings through the winter, and which I therefore recommend for a general practice, is as follows. At or near the north west corner of your Vineyard or Garden, the fence being good and close, let a small trench be dug five or six inches deep and wide, and so long as may contain all your branches. In this plant them thick and close with the but ends down, and fill up the trench, as you go, with the ground, that came out of it, and press it down well with your hand, all about the bottom of your branches; let the dirt rise two or three inches above the surface of the ground, to prevent the water from settling about the Vines, which would rot them. Between every sort, drive down two stakes and fix a label to one of them to distinguish the Vines from each other by their proper names. Before you plant your Vines in this manner, drive down two or more crotches, according to the quantity of Vines,

And method
of
preserving
them over
the winter.

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at about three feet from the trench, and parallel with it, upon which poles are laid, to support the upper part of the branches about twelve or fifteen inches from the ground. Thus they all lie sloping without touching the ground, which preserves them from growing mouldy and from rotting. The Vines then are covered with straw, laid lengthways upon them up and down a little beyond the trench, so that the water is carried off beyond the foot of the Vines by this straw roof; and yet the straw must not be laid on too thick, lest it continue moist too long, and occasion mouldiness. Across the top, a pole is laid, and across the bottom, and fastened down to prevent the straw from blowing away. Thus they remain 'till spring.

Time of
planting.

IN the beginning of April when you are ready for planting, the weather being moderate and calm, the frost out of the ground, and nature teeming with fresh vegetation, then cut your branches for planting. If one cutting from every branch be sufficient for your purpose, then cut the lower part about twelve or fourteen inches long. But as it is most likely, that you will not be so lucky, as to have enough of these, then do what necessity requires, and make two or three cuttings of every branch, not less than a foot long; and having a trench made ready, place them in it close together, the but or lower end down, and cover them up with earth to the upper eye 'till you are ready to plant, carefully placing every sort by themselves, with a label denoting the kind. This direction is calculated for the three bread colonies. The more northern colonies will be a month later, and the more southern colonies will be at least a month, some two months earlier; they must conduct themselves accordingly. To these last colonies, I would recommend the cuttings to be longer, that they may be planted deeper, the better to preserve the Vines from excessive heats and droughts.

Manner of
preparing
the
ground,

Your ground as I said before being well manured and brought into good heart if old, or being naturally rich if new, and having been, at least twice, deep ploughed and well harrowed the summer before, in the fall of the year it must be deep

deep ploughed the third time, and always across the hill or rising ground, and let it lie rough just as it is ploughed, all winter, which will greatly prevent washing, and the frosts will mellow it and prepare it the better for vegetation.

IN the spring of the year, as soon as the ground is dry, let it be well harrowed both ways, with a sharp iron tooth harrow and laid down smooth and even; and take this caution along with you, which I now give once for all, never to meddle with the ground of your Vineyard when it is wet, or even moist at top, nay, I would have you avoid as much as possible, walking in it at such a time. Your own experience will soon teach you, the reason of this caution. For you will find that, the lighter and more open and loose the soil of a Vineyard is kept, the more the Vines will flourish, and the more fruitful they will prove.

WHEN your ground is in proper order, provide a small stake of four feet long for every Vine; and begin to lay out your Vineyard in the most regular manner the nature and shape of the ground will admit of. If you mean to plough and harrow your Vineyard, with a small single horse plough and a small corn harrow, you must leave a border of ten or twelve feet on each side of every square, to turn your horse upon, lest he tramples upon and destroys the outside Vines. There will be no need of such borders along the upper or lower side of the squares, unless you choose it for regularity's sake; because your Vineyard should never be ploughed up and down hill, but transversely, unless you mean to have it gullied, and the rich soil wash'd away by hard rains. And of laying it out.

THE following method of laying out a Vineyard, I think is as easy, as regular and as expeditious as any, for a long square or a four square piece of ground. Your squares being laid out, and having concluded how far your Vines shall stand every way from one another, in which every man is to please himself; you stretch a line of a proper length, and stich small pieces of red, blue, green or any other coloured cloth at such distance from each other as you mean to plant your Vines. I will suppose eight feet, because upon the most mature deliberation, I think that the best distance for Vines to stand at in this country, as I shall afterwards shew more fully. THE

THE line being ready, stretch it along the head or upper part of your square, so that a rag appears at each corner. Then drive down a stake at every rag: This done, move your line down to the lower side of the square, which is opposite to the first, and stretch your line along that, having a rag at each corner, and drive down a stake at every rag: Then turn your line the other way up and down, and fasten your line to the upper and to the lower outside stakes, so that a rag be at each stake, and drive down a stake at every rag, and so go on from stake to stake, till the whole be compleated. If you have been careful not to disturb or move the line, when you drove down the stakes, and have driven them all on the same side of the line, your square will be uniform, and the stakes, near the ground, will range exactly every way.

If your Vineyard be large enough to divide into four, six, eight squares, or more, according to the different sorts of Grapes you design to have in it, and you are not pinched for room, you will find it very convenient on many accounts to have cross walks of twelve feet, between the squares, not only to turn upon when ploughing, but for carting in of dung, and placing it handily for dunging the Vines, which will be a great saving of labour, besides being attended with many other advantages.

Method of
planting
the cut-
tings.

HAVING staked your ground, which ought to be done when it is dry, because it will save you a great deal of labour, in making it loose and mellow again; and having as many Vine cuttings as you can plant in half a day, soaking in rich dung water, in a pail, which serves best to keep the plants upright, the but ends being down, dig holes at every stake larger or smaller, according to your own fantasie and judgment: For it matters not, so they are deep enough to contain the plant. But here I must clear up a point, which has led many people into mistakes and rendered this work more tedious, and that is the throwing into the holes, in which the Vines are planted, rich mould mixed with old dung, thinking that this must be a great advantage to the Vine. This is a great mistake. For as soon as the Vine shoots its roots, beyond this rich mixture, into

into the common soil, which is many degrees poorer and colder, the roots, at it were, recoil and shrink back at a coldness and poverty, they had not been used to, and the vegetation is stopped, and the plant dwindles into poverty and barrenness; and if you examine the plant at bottom, you will find that instead of extending its roots to their usual length, it has shot out a great number of small fibres like threads, which extend no farther than the good mould, and these being quite insufficient to answer the demands of nature, the plant perishes, or remains in an inactive and barren state. Whereas, had the Vine been planted in the common soil at first, it would have met with no alteration, no sudden change to check its growth. This shews that the soil should be well mixed; and let me tell you once for all, that the Vine delights in a warm, comfortable, fruitful soil; but proves unfruitful and perishes in a soil cold and barren. Yet a soil may be too rich, or made too rank by dung, and this extreme is also to be avoided. But to return to planting our Vines, the holes being dug according to your mind, plant your Vine, setting the foot forward from the stake, and bend it a little, without cracking the bark, and bring it gently up against the stake, so that one eye only remains above the surface of the ground. Let not the eye touch the stake, but look from it. Then mixing the ground well together, throw it in and press it gently about the Vine, till the hole is almost full, and throw the rest in lightly, without pressing, so that it may rise up to the eye of the Vine, which ought to be about two inches above the common surface. By this means, the Vine will be preserved from drying winds and the hot Sun, till it begins to grow. Some place four or five paving stones about the foot of the Vine, not so close but that the roots may shoot out between them, and these they say, and I think with reason, condense the air in hot dry seasons, and nourish the Vine with moisture, and cool and refresh it when parched with excessive heats. In the northern colonies, the Vines should be planted on the south side of the stakes, for the sake of the Sun: In the southern colonies, they should be planted on the north side to avoid too great heat. The upper eye only should shoot out branches, from which the head of the Vine is formed. If any shoots should rise from below,

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which sometimes is the case, the sooner they are removed the better, these are called suckers, and very much exhaust the Vine. And thus you proceed till all be finished.

WHEN your Vines are all planted, if you have any cuttings remaining, plant them in a nursery or along the north side of your stakes, for you will have occasion for them, as many of your Vines will miscarry, and the sooner their places are supplied the better. If some of your Vines do not shoot till July, do not give them up, they may grow notwithstanding. I have had many, that have not shot till August, and yet have done well. And here let me tell you that, the filling up all the vacancies, where the Vines have failed or miscarried, is absolutely necessary to be done as soon as possible, either the fall after the Vines were planted, with plants, if you have any growing in your nursery, which are best planted as soon as the leaf is fallen; or the next spring, with cuttings, which is the best season for planting them; for the latter having no root suffer greatly in the winter season, and if planted in the fall, most of them perish. If the vacancies should by any means be neglected for three or four years. You will find it very difficult to raise thrifty and flourishing Vines in such places afterward; because by this time, the neighbouring Vines have shot their roots all round the spot, where the young Vine is to be planted, and will so draw away the nourishment, and entangle the small tender roots, that first shoot from it, that it will not be able to shoot forward and flourish. Some, for this reason, plant two cuttings in a hole, least one should miscarry. To this the chief objection is, that hereby the regularity and uniformity of your Vineyard is hurt, many of the Vines standing out of rank and file. For a well regulated Vineyard resembles a fine regiment under proper and exact discipline. If some of your Vines prove weak the first summer, and do not recover strength the second summer, though manured and cultivated well, root them out, for they very seldom are worth raising; and plant healthy Vines in their stead, out of your nursery; so shall you have a healthy, flourishing and well constituted Vineyard.

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By this time you see the necessity of having a supply of young Vines from a nursery, a circumstance that is by no means to be neglected.

In digging up the plants from your nursery, be careful to take them up without wounding or bruising the roots, and having a pail or small tub, half full of rich dung water, put the plants, with the roots down, into that, so shall they be preserved from the Sun and drying winds, which would soon parch and dry up these young tender roots and kill the Vine. When you have dug up about a dozen or twenty plants, then proceed to planting, which must be done in the following manner. Your holes being dug deep enough and sufficiently wide, for the roots to be spread in at full length, throw in some loose earth, and spread it over the bottom of the hole, and fix in your plant near the stake, so high that the little branches rise an inch or two above the surface of the ground. The roots, you will perceive, for the most part grow in rows, one above another. The upper roots of all, which are called the day roots, must be cut away; the under roots of all must then be spread at full length, and cover'd with earth, then the next must be served in the same manner, and so on till all be regularly extended and covered. This is pursuing of nature, which in these cases, is generally the best director. So shall the earth be well settled about the roots, and the Vines in the spring will grow and flourish, as if they had not been moved or transplanted. If a servant, or even a gardener be left to manage this work, they will be apt, as I have often seen, to set the plant in the hole, in a careless manner, with all the roots huddled together, and so cover it with earth. This is so contrary to the order of nature, and to common sense, that the difference is plainly seen without farther explanation; and indeed most of the miscarriages in life are owing to inattention and carelessness.

The method of planting young vines out of the nursery.

Your Vines being all planted as above directed, and the Vine cuttings, with one eye only above ground, and that almost covered with light earth, to preserve them from suffering with heat and from drying winds till they begin to grow; this

upper bud only will shoot out branches, and the lower ones will throw out roots : And this is much better than to have two or three buds above ground, and branches growing from them all, which only serve to weaken the Vine, and to hinder the forming of a good head, which is the first and chief point to be gained and well secured.

The cul-
ture of
vines
when
young.

WE now proceed to the management of the Vine in its infant state, upon which will very much depend the success of your Vineyard.

THERE are but two ways of forming and managing of Vines to advantage for Vineyards, by stakes, or espaliers. In ancient times, it was common for Vines to be wedded to trees, and they had the poplar, the ash, or the elm for their companions and supports, but men soon discovered the great inconveniency of following nature in this respect. They found, that these trees were difficult to raise in high dry grounds, where Vines were proper to be planted ; that when they did grow, their roots were very much in the way of the Vines, and of working the land, and also drew away too much of the strength of the ground ; and they mounted the fruit so high, that it became very difficult and took up a great deal of time to gather it, for which reasons this method has long been laid aside. As for wall fruit, the Vines that are fixed to walls must be managed in the same manner, as those which are designed for espaliers, that is, the head of the Vine is at first formed about three feet from the ground. But this I shall particularly explain, when I treat of the management of Vines for espaliers. I shall begin then with the proper culture of Vines that are designed for stakes.

IN this case the head of the Vine is formed near the surface of the ground, as I have already more than once observed ; and this method is now generally practised throughout Wine countries, and indeed it is the only method proper for countries, where the frosts in winter are so hard as to hurt Vines, by which means the next year's crop is destroyed. There is no way to prevent this, but by covering the Vines in winter, which

which cannot well be done, when Vines are fixed upon frames or espaliers, without great difficulty and labour, as well as danger to the Vine.

THE first summer after the Vine is planted, you have nothing to do, but to tie up the little branches to the stakes with a soft band, as soon as they are grown about a foot or fifteen inches long, which will save them from being torn off by hard winds, which would endanger the Vine. Besides they grow the stronger and the better for it, and are out of the way of the hoe, the plough and the harrow. You are also to keep the ground clean and free from weeds and grafs; for they are great enemies to Vines. If the ground be kept mellow and loose, your Vines will grow and flourish the better. If you have any litter, short straw and chaff, the shives of broken hemp or flax, the chaff of flax seed, the dust and chaff of buckwheat, and the straw trod fine with horses when it is dry, any or all of these spread over your Vineyard after it is hoed or ploughed and harrowed, will keep down the grafs and weeds, keep the ground moist and light, and will greatly preserve the good soil from washing away. If this be done the first three or four years, it will greatly forward the Vines, bring the ground into good heart, and finely prepare it to produce good crops, by keeping it loose, airy and light, in which Vines greatly delight.

Summer
culture
the first
year.

IN the month of September, when the leaf begins to wither and fall off, which is the best time for trimming of Vines, as I have already observed, cut down all the branches, to one good bud each, and always remember that the lowermost bud next the old wood, is called the dead eye, and is never reckoned among the good buds. When your Vines are thus trimmed, let a careful hand take away the dirt from the foot of the Vine, about four inches down, and cut away all the upper roots that appear above that depth. These are called day roots, and must be taken away every fall, the first three years. The best way is, not to cut them off close to the body of the Vine, but about a straw's breadth from it, so shall they not be so apt to grow again. These upper or day roots greatly weaken the Vine, and hinder the lower roots from extending themselves, and

Fall culture
the first
year.

and from firmly fixing themselves below, on which greatly depend the strength, firmness and durableness of the Vine, and also its fruitfulness. Besides by these roots running deep, the Vine is preserved from perishing in long tedious droughts. Let the foot of the Vine be left open, after the day roots are cut away, that it may dry and harden, till the hard frosts come. Then the holes are to be filled again, and the head of the Vine covered with chaff and short straw mixed, or with bog hay, or salt hay, or with horse litter, that is free from dung and grass seeds; for these should be carefully kept out of a Vineyard, which will save the labour of rooting out the grass that would spring from them. Some cover the head of the Vine with the ground when they fill up the holes; but this is wrong, it greatly endangers the Vine, as I have found by experience, for I have lost many of them by this management, before I discovered the danger. The ground, in warm rains, moulds and rots the Vine. For the same reason, suffer no dung to be among the straw, hay, or horse litter, with which you cover your Vines. The heat of the dung, in warm rains or muggy warm weather, will mould and rot them; the cooler and dryer they are kept, the better. I have told you before, and I now repeat it, (because it is a work that must by no means be neglected,) when you trim your Vines, if you find that any of them have miscarried, which is very common, plant others in their room immediately, if you have any plants of the same sort growing in your nursery; if not, then do not delay to provide cuttings of the same kind, and preserve them till spring, as you were before directed, and plant them in the vacant places, that your Vineyard may be full and compleat as soon as possible, so shall it grow and flourish the better.

Summer
culture
the second
year.

THE second summer you will find more branches shooting from the heads of your Vines, than did the first summer; and here the skill of a Vigneron is necessary for forming the head of a Vine in the best manner. Let the shoots grow, till they are ten or twelve inches long, then choole eight, that are short jointed and much of a size, that grow on all sides of the Vine, and with your finger strike off all the rest. If any one branch among the whole number, appears much more thrifty than the

the rest, you may perhaps be tempted to save it; but let not your eye spare it. It will only prove a thief and a robber. It will draw to itself the chief nourishment of the Vine, and starve the rest of the branches, and after all will bear but little fruit. The short jointed branches, prove the best bearers, and these standing on all sides of the head, preserve the Vine in full strength and vigor. For this reason the rounder the head of the Vine is formed, the better. If the branches be suffered to grow from one side of the head, the other side suffers greatly, and is apt to perish.

THIS year there should be two stakes to a Vine, one on each side, to fasten the branches to, by this means they are spread at a distance from each other, and grow the stronger and better; the Sun, air, and winds come to every part; the wood ripens well, and the buds fill, and they are the better prepared to become fruitful in due time. Whereas, when they are huddled altogether, and fastened up to one stake, they suffer greatly for want of the Sun and air to dry them after rains, mists and heavy dews; and in close muggy weather, they will mildew and rot. Let therefore the branches be tied up singly to the stakes on each side, with a soft band, as soon as they are long enough, lest they be torn off by hard winds, which would ruin the Vine. I need not tell you again, that your Vineyard is always to be kept clean and free from weeds and grass; and the dryer the ground is, and the hotter the weather, the more effectually they are destroyed, by hoeing, ploughing and harrowing. But remember never to meddle with your ground when it is wet, you do more hurt than good.

THIS second summer your main branches should be suffered to grow about five feet long, and then the ends of them must be nipped off, in order to curb them, to keep them within proper bounds, and to hinder them from growing wild. The lateral or secondary branches should be nipped off at the end, when they are about a foot long, the nephews also should be nipped off when they are about six inches long. This is much better, than the taking all these smaller branches clean away, which is the practice of some, who are more nice than wise.

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For I have found, by experience, that, when these secondary branches are clean taken away, the main branches suffer ; they grow flat, and appear distorted ; which plainly shews, that nature is deprived of something, that is essentially necessary to her well being. It is quite necessary to nip off the ends of the main branches, when they are grown about five feet long. They grow the larger and stronger, the wood ripens the better, the lower buds are well filled, and better prepared for the bearing of fruit. Besides it teaches the Vines to become reconciled to a low and humble state, it curbs their pride and ambition, which is always to climb and mount up above every thing that is near them, and educates them to bear fruit within your reach. Some time after the tops of the main branches are nipped off, they will shoot out a second time, and then they generally throw out, from near the end, two branches instead of one ; so prone is the Vine to shoot and extend itself, these also must be nipped off ; at the same time the lateral or secondary branches must be looked to and nipped off, if any of them are shooting out anew.

The fall
culture
the second
year.

IN the fall of the year, as soon as the leaf begins to wither and fall off, which happens earlier or later, according to the weather, cut the branches down again to one good bud each, and take away the earth round the heads of the Vines, as before directed, and cut away the day roots, and manage them just in the same manner as you did the fall before. Now as some of your forward Vines will bear fruit the third year from the planting, which is the next year, and as it is natural for you to desire fruit, and especially to know what sort of fruit, and how good, your different Vines will bear ; to satisfy your curiosity, I would advise you to set aside two or three at most, of each sort of your most thriving Vines for that purpose, and instead of cutting down all their branches to one bud each, like the rest, leave two branches on each of these Vines, with two or three good buds each, which will shew some fruit to your satisfaction. But be persuaded to prevent the rest from bearing fruit till the fourth year, and the weaker Vines till the fifth year, and your Vineyard will make you ample satisfaction, for this piece of self denial. For it greatly weakens a Vine to bear

bear fruit when so young ; and however fond most men may be of their Vines bearing much fruit, the overbearing of Vines, is allowed on all hands, to hurt them greatly. To prevent which, in Wine countries, where it is common to lease out Vineyards to husbandmen, whom they call Vignerons, they have very strict laws, obliging them to leave four, six, or eight bearing branches on a Vine, according to the age of the Vineyard, the strength of the Vines, and the goodness of the soil, and according to the custom of different countries where good Wines are held in repute, to prevent their hurting the Vines, and the reputation of their Wines. These Vignerons are likewise obliged, after three fruitful years, if so many happen successively, to let their Vineyards rest one year without bearing fruit, that they may have time to recruit and gather fresh strength.

THE third summer you are to manage your Vines in the same manner you did the second, tying up all the branches to the stakes, one above another ; only of those Vines that are to bear fruit, the fruit bearing branches should be tied up above the rest, that the fruit may have the benefit of the Sun, the air and winds, all which are necessary, and conspire to bring the fruit to maturity ; and this should always be the practice. This year a third stake is provided, which in the spring is drove down just on the north side of the Vine, upon a line with the rest, for order sake. To this stake the branches that bear fruit, there being but few of them, will be best fastened, because there will be the more room for the branches of reserve, which are to bear fruit the next year, to be distinctly fastened to the side stakes. These branches of reserve are now of great importance to the owner, as the next crop will depend upon the right management of them. They are, therefore, to be carefully tied up at proper distances, to the side stakes, that they may grow well, that the wood may ripen, and that the buds may be well filled. When they are grown about five feet long, the ends must be nipped off, the lateral branches kept short, and the nephews restrained, if they grow too long, so shall the main branches appear full and round, and in a natural, healthy and flourishing state ; whereas, if they are all tied up to one

Summer
culture
the third
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stake,

stake, as is the practice with some people, the wood remains green and spongy, and does not ripen, the buds do not fill well; and where the band is, all the branches will dew and rot; which plainly shews the badness of such management. As to the few Vines that bear fruit this summer, let the fruit bearing branches be nipped off five joints above the fruit, and let the side branches and nephews be kept short as above directed; so shall the fruit come to perfection.

Fall culture
the third
year.

IN the fall of this third summer, preserve two of the best short jointed branches of reserve, one on each side of the head of the Vine, for bearing fruit the next year: The rest cut down to one good bud each. If some of your Vines be very strong and flourishing, you may preserve four branches for bearing fruit, but by no means more, one on each quarter of the Vine, so shall they bear fruit the better. As to the branches on the few Vines, that bore fruit this year, they must be cut down to one good bud each; for the same branch must never be suffered to bear fruit two years running, unless you fall short of branches of reserve, in that case you must do what necessity requires, and let the old branch bear a second time, but they seldom or never bear so large clusters, nor so fair fruit. On these Vines, that bore fruit this year, not above two branches on each, should be kept for bearing fruit the next year, so shall you preserve their strength from being exhausted when young; they will last the longer, and bear fruit the more plentifully hereafter. The rest of the management is the same with that of the last year; only some time in the latter end of November or somewhat later, if the hard weather keeps off, a small long trench on each side of the Vine, is dug with a hoe, and the branches that are kept for bearing fruit, are laid down gently into them, without forcing them, so as to crack them, or split the bark, or strain the wood too hard, and must be covered over with the earth. If any part appears above ground, it must be well covered with straw, bog or salt hay, and indeed if the whole that are buried were also covered in the same manner, with straw, &c. it would be best; for the branches being of an elastic nature, they are very apt, upon the thawing of the ground, to rise with their backs above the ground, and remain exposed.

exposed to the weather, so that your crop may be lost notwithstanding your trouble, which a small covering of straw or hay will prevent. If any of them should be so stiff and stubborn as not to bend down, then bind straw round them and the stake.

In the spring of the fourth year, the branches that have been preserved for bearing fruit, must be carefully trained up to the side stakes, the higher the better; and the branches that shoot out from the head this spring, which are called branches of reserve, and are designed to bear fruit the next succeeding year, must be tied up to the stakes below the fruit bearing branches, and one or two to the middle stake, if there is room, for often times the fruit bearing branches, occupy the middle as well as the side stakes, and especially in a plentiful year. The management of the Vine in its bearing state, calls for a close and particular attention. Some gentlemen, and those who have written best upon this subject, recommend the taking away all the lateral or secondary branches and the nephews, close to the body of the fruit bearing branch, and to leave only the main leaves of that branch, thinking, by this method, that all the nourishment of the Vine is thrown into the fruit. They also order the top of the branch to be taken off, within three joints of the uppermost cluster of Grapes. Others again are for following nature, and suffer all the branches to extend themselves as they will. These I look upon to be, two extremes, and think that a middle way, is every way best, most rational and safest. The lateral branches, the leaves and nephews are supposed by naturalists to draw off and perspire the crude and thin juices and to hinder them from entering and spoiling the fruit, and also serve as lungs for respiration; the circulation of the air through all the parts being necessary to vegetation, and for bringing the fruit to perfect maturity. That this is so, or how it is, I am not so well acquainted with the operations of nature, as to determine; but this I know, that when these smaller branches are taken clean away, the main branches instead of growing round, full and plump, which is their natural state, become broad, flat and distorted, and have an unnatural appearance. Besides these branches, when kept within proper bounds, serve to shade the

Culture of
the vine
in its
bearing
state.

fruit from the scorching rays of the Sun, and to screen them from violent winds, from hail and beating rains, from damps and fogs and cold nights dews, which are all injurious to the fruit, as well as the cold dry north-east winds, and the cold driving north-east storms. But let not this lead us into the other extreme, for if the Vine be left to herself, and all be suffered to grow, she will run wild, and ruin all by her own excess. This is the method of managing Vines when the head is formed near the ground, which is now practised in most Vine countries in Vineyards, (except some parts of France, where they are still fond of espaliers,) and this method must be continued as long as the Vines last, which most writers do affirm, will be above a hundred years. As to the management of Vines in gardens, against walls, and for forming of shady places, and many other ways to please the humour and phantasy of the owner, that is not to be regarded, it has no relation to Vineyards.

A new method of trimming and forming the heads proposed for trial.

HERE I would propose a new method of managing Vines, the heads of which are formed near the ground, by way of trial; I have not yet made the experiment, if it should answer, it would save a good deal of trouble, and be more secure against the severities of the weather; I have been told that it is the practice of some to cut all the branches down, and to trust to new shoots for bearing of fruit; and I have read the same account in a treatise published by James Mortimer, Esq; Fellow of the Royal Society, in the year 1707, but these accounts are so vague, so general and superficial, without entering minutely into any particulars, that I could have no dependence upon them; nor could any man form a judgement of the manner of doing it. However from thence I have taken the hint, and shall now propose a method which may be worthy of trial. In the fall of the third year of the Vine's age, instead of saving two or four branches for bearing fruit, cut down these to two buds each, and the rest cut down to one bud each; the upper buds of these branches that have two buds, are designed to bear fruit, this next year, the lower buds and the buds of all the rest are designed for fruit the year after, and therefore if any fruit should appear upon them, they

they must be taken away as soon as the clusters appear; in the fall of the fourth year, cut all the branches that have born fruit clean away, and leave those that did not bear fruit; and then according to the strength of the Vine, cut as many of these down to two buds, as you think your Vine ought to bear, and cut the rest down to one bud, always remembering that the branches that have but one bud, and the under bud of those that have two, are to bear no fruit. When your Vines come to be strong and able to bear it, cut down all the branches to two buds, and then you will have eight bearing branches in one year, which are quite enough for the strongest Vines; however if you have a mind to strain your Vines, and to try how much they will bear, you may then cut as many branches as you think fit down to three buds, two of which may bear fruit, while the under buds are kept for branches of reserve. In the fall, all the fruit bearing branches are cut clean away. If this method should succeed to your mind, and you think it preferable to the method first laid down, I mean that of preserving branches of reserve to be laid down and covered in winter, which is the German method, and the general practice of the Rhine, &c. then in order to bring your older Vines into this method, cut down the fruit bearing branches to one bud the first year, and the branches of reserve you may cut down to two or three buds each, as you think your Vines are able to bear it. In this you form your judgment, from the strength of your Vine, the goodness of your soil, the distance of your Vines from one another, and the quantity of fruit they have born the three preceeding years: for Vines, as well as men, must have time to rest and recruit, if you mean them to last, and to return to their work with vigour.

Now for the covering of these Vines in the winter season, I would advise a handful of soft hay, that is free from grass-seeds, to be laid on the head of the Vine, and a slight box made of rough cedar boards, or of pine, (which any servant may make, only let the top piece cover the whole,) be put over the head, which will be a safe and sufficient covering. Otherwise a small sheaf of straw, bound well round the stake, and

and the bottom brought handsomely all round the head of the Vine, and secured by a band from blowing open, will do very well. The Vines should not be covered till hard weather is ready to set in, and they should be dry when covered.

General directions BEFORE I proceed to the management of Vines for the frame or espalier, it will be necessary to acquaint you with some things of a general nature, which you will find worthy of notice.

**About
triming
vines.**

WHEN Vines are trimmed in the fall, which they ought to be as soon as the Vintage is over, or as soon as the leaf withers and falls off, they seldom bleed, and never so as to hurt them. If Vines have been neglected and not trimmed in the fall, and this work must be done in the spring, let it be done in February, if good weather happens, or early in March. If it be done later, they will bleed too much, and endanger the crop. Searing the wound, as soon as it is made, with a hot iron, it is said, and I think with reason, will prevent the bleeding. In trimming, keep about two inches from the bud, or half way between bud and bud: so shall the upper bud that is left be free from danger. The rule is, to cut sloping upward, on the opposite side to the bud, that the slope may carry off the tears from the eye, but I never found this any kind of security to the eyes below. If therefore searing every wound with a hot iron be thought too much trouble, the only remedy, besides that, which I have yet been able to discover, is, to wash the branches that are wounded and bleed, and especially the buds, with a rag dipped in warm water, without touching the wound, which in 8 or 10 days will stop of itself; the liquor forming a stiff jelly upon the wound, like coagulated blood, and drying by degrees, heals up the wound. The washing must be deferred till they have done bleeding. Unless this is done, the eyes below will be in danger of being blinded. For so glutinous is the sap, that it binds up the bud it reaches, so that the leaves cannot open and unfold at the time of vegetation. In cutting off large limbs from old Vines, it sometimes happens that ants fall upon the pith, eat their way in, and make a hollow,

low, where the water settles and rots it. In this case the remedy is, to cut such branches close down to where it is solid and green, and it will bark over and heal.

It is common for large buds to shoot out two or three branches each. One only on each should be suffered to grow; if you expect fruit on them, be not in a hurry to strike them off, till you know which is most fruitful, and save that. Vines that are close planted in a Vineyard, cannot be expected to bear so much fruit, as single Vines, or as those that are planted at a distance. Their roots are too much confined, so that they cannot gather nourishment in so small a compass of ground, to support and bring to perfection a large quantity of fruit; and this is a sufficient reason for restraining them, and for limiting the number of bearing branches, if you mean to make good Wine, to keep your Vines in full vigour and to preserve them for many years. Besides the deficiency is fully made up, by a greater number of Vines; and the planting them close, enables you the better to keep them low and within proper bounds.

The number of branches that should be suffered to grow.

VINES that bear black or red Grapes generally shoot forth a greater number of branches, and more vigorous than those that bear white Grapes, and therefore the latter require more caution in trimming, and more care in the cultivation and management of the soil, that it be kept clean and in good heart.

WHEN Vines have been covered with earth during the winter season, let them not be uncovered in the spring, till the hard frosts are over, and then let it be done in a fair, warm, drying day, that they may dry before night, for if they should freeze before they are dry, it would greatly hurt, if not ruin the crop.

Time of uncovering vines in the spring.

THE head of the Vine, properly speaking, when it is formed near the ground, is composed of the but ends of the branches, that are cut down to one good bud each, which ought to be eight at least in number. These branches, the second year of the Vine's growth, shoot from the solid wood chiefly,

Forming a proper head.

chiefly, and then is the critical time to prepare for forming a proper head to a Vine; therefore preserve eight of the best short jointed branches, that grow on all sides of the stock, and much of a size, and these must be carefully tied up singly to the stakes, that the buds may fill well, and that the wood may ripen, on which greatly depends the future success of your Vineyard, as this is the foundation of the whole. If more than eight branches have grown from the head, the rest must be struck off with the finger. If one of the branches outgrows the rest and appears more flourishing, that in particular must be struck off. For if suffered to grow, it will rob the rest of their due proportion of nourishment, and ruin the Vine. Eight branches are sufficient for a thrifty young Vine, four of which are intended for bearing fruit, when that time comes, and the other four are designed for branches of reserve. The third year, which is the first year of the Vine's bearing, the lowermost good bud on the bearing branches, will produce one or two clusters of Grapes each. The fourth year, two or three of the lowermost buds will bear fruit, and after that five or six of the lower buds will bear fruit, but seldom more; so shall you have five or six branches, growing from each bearing branch, producing fruit, which makes twenty or four and twenty bearing branches upon one Vine, and each of these branches yielding two three or more clusters, according to the fruitfulness of the year, and the due cultivation of your Vineyard.

NAY if your Vines are well chosen, as I have directed, and properly cultivated, and your soil kept clean and well improved, you shall, in a fruitful year, see some of the secondary branches and even the tendrils bearing fruit. This happened to some of my Vines in the year 1767. I had four successive crops hanging on several of my Vines at one and the same time, one under another, which I shewed to several gentlemen, who admired, and were surprized at such a production: But I took away all but the first crop, lest my Vines might be too much weakened by over bearing. I mention this to shew what nature will do in a favourable year, under proper management. And here I must remark, that the greater the Vintage, the better the Wine, but a meagre thin crop produces thin weak Wines,

Wines, which require dexterity and art to make them fit for use; but this I shall instruct you in, when I come to the making of Wine.

In transplanting Vines or trees of any kind, I have by long experience found, that removing them in the fall, after the leaf is fallen, is much surer and safer, than doing it in the spring. For if trees are well staked, so as to stand firm against hard winds, the ground will be so well packed about the roots, that they will grow in the spring, as if they had not been removed, and are in no danger, if a dry season should happen, especially if some horse litter or old hay be thrown round them in the spring, so as not to touch the stem. Whereas if they are removed in the spring, and a drought succeeds, before the ground be well settled about the roots, many of them will miscarry.

Trans-
planting
vines, &c.

As Vines are best planted upon rising grounds to prevent too much wet, and as it is necessary to keep the soil loose and mellow, it thereby becomes the more liable to washing away by hard rains, which must be a great injury to a Vineyard; now if by any means so great an inconveniency might be avoided, it would be a great point gained, and therefore it very well deserves our attention: For it is no small cost and labour to renew the soil, that is sometimes carried off by sudden floods of rain. I have tried several ways to prevent this evil, so as neither to injure the Vines, nor hurt the crop. The following method, where a person has the conveniency, I find to be the most effectual. Lay broad flat stones, not exceeding two inches in thickness, close along the lower side of the Vines, after the ground has been made loose and mellow. These stones being broad, and not very heavy, do not press hard upon the roots of the Vines, nor pack the ground too close. They reflect great heat up to the Vine and fruit, which helps to bring it to full maturity; they preserve the soil from washing away, they keep the ground moist in the driest times, and hinder too much wet from penetrating down to the roots near the head of the Vine, which chiefly occasions the bursting of the Grapes, when they are near ripe, after a shower of rain. To

To prevent
the soil on
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prevent this evil, is one reason for cutting away the day roots, which extend themselves along near the surface of the ground. But where such flat stones are not easy to be had, I would recommend short straw mixed with chaff, the shives of flax and hemp, the chaff of flax seed, which is also an excellent manure, old half rotted salt hay, or bog hay, free from grass seeds, spread thin between the rows; if it be spread thick, it keeps the ground too long wet and cold in the spring, which retards or keeps back the growth of the Vines. These I have experienced to be profitable, and very much to hinder the soil from washing away. On the side of steep grounds, of hills and mountains, stones in proportion to the descent, or logs of wood, where stones are not to be had, must be laid along the lower side of the Vines, to keep the soil from washing away, which otherwise it will do, to the great damage, if not the ruin of your Vineyard, and therefore when you begin a Vineyard, remember that this is one, and an essential part of the cost.

The site of
a vine-
yard.

A VINEYARD will thrive the better, and the crops will be more sure, if it be well screened, by some good fence, buildings, mountain, or thick cops of wood at a small distance, from those points that lie to the north of the east, and to the north of the north-west; the winds from those quarters, in the spring of the year, being very unfriendly to Vines. But then a Vineyard should be quite open to all the other points of the compass. For Vines delight much in an open, clear, pure warm air, free from cold damps, fogs, mists, and from condensed air, arising from bogs, swamps, and wet clay grounds, and from large tracts of neighbouring woods. The north-west winds, indeed are rather advantageous to a Vineyard: For although in America, they are extremely cold in winter, and occasion severe frosts, yet as the Vines are then covered, they do them no harm. Besides those winds are generally drying and seldom bring wet; in the spring and summer they are always cool, and I find by long experience that they are quite necessary, to brace up, harden and confirm the leaves and tender new shot branches of all trees and vegetables, which otherwise remain languid and weak.

THERE

THERE are three seasons when careful and experienced Vignerons deny access to their Vineyards, first when the ground is wet, because then the weight of a man presses down and packs the earth too close and hard upon the roots of the Vines. Secondly, when the Vines are in blossom, because if they are then disturbed by handling, shaking or rubbing against them, the farina or fine dust that is formed on the blossom, which impregnates or gives life to the fruit, is shaken off and the fruit miscarries. Thirdly, when the fruit grows ripe, because the temptation is too strong to withstand, and people will pluck off the fairest ripest Grapes, which Vignerons do say is an injury to the whole bunch; be that as it may, it certainly is a great injury to the owner, for the fairestripest Grapes make the richest and finest flavoured Wines.

I now pass on to the management of Vines upon espaliers: Method of
managing
vines for
espaliers. But then you are to remember that, the training up of Vines to these frames, is only fit for the southern or warmer climates, where the winter frosts are not so severe, as in our more northern regions; for as they are to stand exposed to all weathers, the germ or bud, from which the Grapes do spring, are apt to be chilled and destroyed by the severity of a sharp season, and especially by moist sticking snows freezing hard on the branches.

THE first year the young Vines are trimmed and managed in First year. the same manner you have been before directed.

THE second year, when they always shoot forth a greater Second number of branches, is the time for making choice of the best year. branches for standards. Set apart, therefore, two of the best short jointed branches, on each Vine, for that purpose, that you may be secure of one, in case the other should fail, as these branches when young, are subject to many accidents: So shall you stand a fair chance of having fruitful Vines; for all Vignerons well know, that Vines shoot forth more barren and unfruitful branches, than fruitful ones, therefore, as experience hath taught them, they always set apart short jointed branches for bearers, because these seldom fail yielding much
U 2 fruit;

fruit; all the rest of the branches you strike off with your finger: Again, would you still more effectually avoid barren Vines, if you have it in your power, choose your Vine cuttings for planting, from fruitful Vines; not only so, but choose fruit bearing branches, that grow from the teeming part of the Vine, that is as near the head and shoulders as possible, and then if you cultivate them well, you shall be sure of having fruitful Vines; and this, let me tell you, is gaining a very grand and essential point: I have here repeated this instruction, that you may not neglect it, nor miss of so great an advantage.

HAVING thus chosen two branches for standards, train them up as strait as you can, one on each side of the stake: When they are grown about fifteen inches long, bind them gently with a soft band to the stake; for they are then yet very tender: And as they grow longer bind them a second and a third time; and when they are grown up to the top of the stake, which must be five feet high, nip off the ends, and they will grow the thicker and stronger. When you have taken away the tops of the Vine she will try to recover herself, and will shoot out two branches at the top instead of one; but these you must also nip off, and keep short, but take away none of the lateral branches or nephews till you come to trim them in the fall, only nip them off to keep them within proper bounds. In the fall when the Vine leaves begin to wither and fall, cut away one of these standards from each Vine, close to the stock, leaving such as you best like, which is now out of danger, and trim away from her all the branches and nephews, and cut off her top within three feet and a half of the ground; leave four buds at the top, and cut off all the ends of the buds below them; all these wounds will be healed before the hard weather comes on, which should not be over severe where espaliers are used; the two upper buds will be the arms of the Vine, the two lower buds will be the shoulders, and just under these the Vine is fastened to the espaliers, and is called the head of the Vine. Now it requires the greatest skill of the most experienced Vigneron to manage and cultivate Vines thus educated and trained up to espaliers; and therefore they are more fit for gentlemen's gardens and the Vineyards of rich men, who can

can afford the expence of these frames, and to employ Vignerons to manage Vines in this manner, in order to obtain the richest Wines, than for common men and men of small fortunes, who must chiefly manage these affairs with their own hands, and for whose sakes I have taken the pains to write this treatise; but that I may do honor to the rich and great, and shew them that respect, which I think due to their distinction and high stations, I will proceed and give such instructions as shall answer their expectations; but then I must beg leave to guard them against pretenders to this art, for there are pedants, and not a few, among Vine dressers, as well as among men of letters. The greatest difficulty, as experienced Vignerons know, is so to manage a Vine, as to keep her within the height and compass of a frame, and yet to cause her to bear fruit plentifully.

THE third summer the espaliers being regularly set up six feet high, in a line with the Vines, the posts being of some lasting wood as of red cedar, locust or of mulberry, which are cheapest in the end, or for want of these, of good thrifty chestnut, that is not worm eaten; and being firmly fixed in the ground, in the middle space between Vine and Vine, and the rails, being four in height, well nailed to the posts, and placed on the north side of the Vines, the lowermost about three feet from the ground, or just below the lowermost bud on the Vine, the Vine must be fastened with a soft yet strong band to a stake firmly fixed down near the foot of the Vine, and fastened to the frame, near the lower rail, the four buds rising above it. When these buds shoot forth their branches, they must be regularly trained up to the rails above, and fastened to them with a soft band; as soon as they are long enough to reach the first above them, they must be fastened to that, and so to the next, &c. as they grow; and this must be done by a careful hand, because these branches, at first, are very tender; if they should be neglected, till they are grown longer before they are tied, they will be in great danger of being torn off by hard winds, to the great damage of the Vine. When the branches are grown up to the top of the frame, the ends must be nipped off even with it, and when from the tops they shoot forth again, they.

Third year.

they must again be nipped off and kept down even with the frame, and this not so much for beauty and order sake, but that they may be properly educated and taught to be humble and keep within the limits assigned them. The lateral branches and nephews also must be kept within proper bounds and not suffered to grow too long, for some of these side branches will steal away to a great length, and rob the Vine of her strength. If any fruit should appear this third year, which may happen, let it be taken away, as soon as it appears, and your self-denial shall be amply rewarded the succeeding year; For it greatly weakens a Vine to bear fruit so young. Besides not only the durableness, but the fruitfulness of Vines, very much depends upon the proper culture of them when young.

IN the fall of this third year, the lateral branches and nephews must be carefully cut away from the main branches, so as not to hurt, or rub against the lower buds, with the back of the knife, which is frequently done, by cutting off the branches too near the germ or bud. For if the thin bark, that covers the bud, be rubbed off, under which is a soft warm garment of cotton, to preserve it from violent colds, the wet gets in, freezes and destroys the germ. The four main branches, that sprung from the four buds, must now be cut down to two good buds each; the lower bud, next the old wood is never looked upon as a good bud, it is called a dead eye, or barren bud; because it bears no fruit, at least not the first year of its growth: And yet notwithstanding you will be obliged sometimes to make use of it, as I shall presently shew. In cutting off the main branches, cut slanting upward, so that the wound appears in the shape of the nail of a man's finger, and let the slope be on the opposite side of the bud, that if it should weep, the tears may drop free of the bud; this is the rule, but I have given my opinion on this precept before, to which I refer you. In cutting, approach not too near the bud, that is left, but keep at two inches distance from it, lest you endanger it, by letting in the cold air and wet upon it, before the wound can heal.

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THE chief point, in managing these Vines, is, the providing branches of reserve for recruiting the arms in such manner, as to confine the Vine within the compass of your frame; for if you raise new arms from the old ones, your Vine will soon outshoot the frame. You must, therefore, seek for new arms from the shoulders: If a branch grows in a proper place, anywhere between the arms and the head, and happens to be broken, clip it into a thumb, that is, cut it down to two or three good buds, as soon as you discover it, and this is called a keeper, and very well supplies the place of a branch of reserve. Sometimes you will be glad to make use of the half starved branch, that springs from the dead eye beforementioned; nay sometimes you are drove to the necessity of nursing up a small bud of two leaves, or a knob or wart for that purpose; and when none of these are to be found, you must wound the Vine in a proper place, somewhere about the shoulders, with a bodkin or sharp pointed instrument, in two or three places, from whence it is usual for a branch to shoot, if it be done sometime in the spring: But if all should fail, you then will be obliged to raise your frame higher, and make use of some of the branches, that grow out of the arms, the nearer to the shoulders, the better: But if you have been drove to this necessity before, and your frame has been already raised to a sufficient height, there then remains no remedy but a desperate one, since the disease is become desperate, that is, to cut such Vines down even with the ground, and from these stumps fresh shoots will spring and bear some fruit, the second year after, if a proper choice be made: They must be cut when you trim your Vines.

IF any fruit should appear on any of the branches, that grow from the shoulders, which is often the case, let them be taken away as soon as they appear, for these being branches of reserve, they are designed to bear fruit the succeeding year, the arms only are to bear fruit the present year: These directions will serve for the fourth, the fifth, and the succeeding years.

IN the fall of this third year, I have above directed you to cut the four main branches, that grew from the four buds,
down.

down to two good buds each, but this is designed for the strong Vines only; those that are weak, must be cut down to one good bud, each branch, so shall they flourish and gather strength the better, and if any fruit should appear on the weak Vines the fourth or even the fifth year, strike them off as soon as they appear, and they will afterwards make you ample satisfaction for this prudent management of them when young and weak; and once for all be persuaded not to overload young Vines with fruit; if from a fondness to outdo your neighbour, you run into this error, your Vines will pine and be at a stand, and will not recover for some years; and then your neighbour, who has cultivated his Vines with more prudence and caution, will triumph in his turn, with greater reason, and with much greater advantages.

Fourth
year.

THE fourth year when you trim your Vines in the fall, you may cut the arms down to one good bud each, instead of taking them clean away, for the Vines being yet young and low, these two buds will in a manner become part of the shoulders, being so near them; these will bear fruit the next, which is the fifth year; and then you can save the two lower buds, that grew on the branches that sprung from the shoulder, for branches of reserve, by taking away the fruit as soon as they appear, and these will bear fruit the year after; so shall you have four branches bearing fruit the fifth year, which is quite sufficient.

THE sixth year you may have three good buds on each branch for bearing fruit, and the seventh year you may have four buds on each branch, which will make eight bearing branches, which are thought by the best judges to be quite sufficient for the strongest Vines, if you mean to make good Wine; and to this number Vignerons are generally confined.

VINES that are designed for espaliers, must be planted further asunder than those, that are intended for stakes; for as they rise much higher with the stem, they require more nourishment, and more room to extend their roots; ten feet is by no means too much; twelve would be better: Suetonius, a
learned

learned man, well known to men of letters, made this remark as he travelled through the Wine countries, that the farther Vines were planted from each other, the better he found the Wine.

ONE general rule is necessary to be laid down, in order to give young Vine-dressers, a clear idea of the nature and manner of trimming Vines, which is very apt to puzzle young beginners; know then, that the young wood, that grew this year, must be preserved for bearing fruit the next year, and those branches, that did not bear fruit, are better for the purpose, than those that did bear fruit; and for this reason, you are above directed to strike off, with your finger, the young clusters, as soon as they appear, from those branches, which you reserve for bearing fruit the succeeding year. When I mention a branch, I mean a main branch of young wood, not a side or lateral branch, that grows upon these young main branches.

WHEN the arms have born fruit, they are cut clean away in the fall of the year, as soon as the Vintage is over, provided you have branches of reserve, growing on the shoulders, to supply their places: But if you have been so unlucky, as to have failed in these, notwithstanding all your attempts to procure them; you must then do what necessity requires, and cut the arms down to two, three, or four good buds each, according to the strength of the Vine; but then remember, not to suffer any fruit to grow on the branches, that spring from the lower bud on each old arm, these being now absolutely necessary for branches of reserve, in order to recruit the arms the next year. According to these rules you constantly proceed with Vines on espaliers.

As some of our southern colonies have a hot sandy soil, and are subject to great heats and parching droughts, and thereby find it very difficult to raise and preserve Vines, so as to become fruitful; I shall here offer some thoughts and directions, which I imagine most likely to succeed in these parching hot countries; as I most sincerely wish comfort and happiness to every

Directions
for the
southern
colonies.

every colony on the continent, and that the whole may become as beneficial as possible to the mother country.

FIRST then, I think it necessary to shade the young Vines the first two or three years, during the hot dry seasons, by driving down firmly in the ground, branches of trees thick set with leaves, on the south side of the Vines; these are better than matts, or pieces of thatch work, as the air and winds can pass more freely through them; it will also be necessary to water these young Vines twice a week, during the hot dry seasons, in the evening, that the water may have the whole night to soak down to the roots of the Vines to cool and refresh them; the branches, in these hot countries, should not be tied up to stakes, but should be suffered to run on the ground to shade and keep it moist and cool. These Vines must be trimmed in the same manner, as those which are designed for stakes, as soon as the leaf falls, or the vintage is over. The third year instead of driving stakes down to fasten up the branches to them, let short crotches be drove down about six foot asunder, and pretty strong poles laid across upon them, so that they may lie about fourteen inches from the ground; and so near to each other, that the branches of the Vines may conveniently run upon the poles without dipping down and running upon the ground; if the ends of the Vines should run beyond the sides of this bed of poles, they must be turned in and confined to their proper bed; because it will be necessary to have a walk or path of two feet wide between bed and bed to regulate the Vines, to cut away the luxuriant suckers, that rob the Vine and the bearing branches of their due nourishment, to gather in the Vintage and to trim the Vines.

THIS bed of poles should be so placed, as to extend three feet on each side of the row of Vines, so that the rows of Vines standing eight feet asunder, there will be a path of two feet between row and row for the necessary purposes before-mentioned. Particular care must be taken, not to take away too many branches from these Vines, unless there should happen an uncommon wet season, nor to keep them too short, because they are designed to shade the ground as much as possible, in order.

order to keep it cool and moist, which is necessary for the growth of the Vine, and for bringing the fruit to perfection; but then in the beginning of August, or about a month before the different sorts of fruits begin to grow ripe, each in their proper time, you should take away the lateral branches and cut off the tops of the main branches, but this must be done, not all at once, but by degrees, some now, some then, and that according to the dryness or wetness of the season, for this must be done to let in the Sun and the air, which, at this season of the year, become necessary to bring the fruit to perfect maturity; the wetter the season, at this latter part of the summer, the more branches must be taken away and the shorter the main branches must be cut, and if necessary most of the leaves must also be plucked off; the fruit will ripen the better, and make the richer Wine, and all this may be done without any injury to the Vines.

HERE I would observe that the same management with regard to the thinning the branches and the leaves at this season of the year, is necessary for Vines that are fastened to stakes or espaliers, in order to meliorate and hasten on the full ripeness of the fruit; and remember that the longer white Grapes hang on the Vines, even after they are ripe, if the season be dry, the richer Wine they make. But it is otherwise with the black Grapes; when they are full ripe, they must be gathered and made up into Wine, if not, they rot and dry away suddenly, and perish in less than a week.

THE Portuguese form the head of the Vine near the ground, but whether through carelessness, the love of ease, or the want of proper materials, I cannot determine, but they have a method peculiar to themselves of managing their Vines; they drive crotches into the ground, upon which they fix strong poles, which lie about three feet from the ground, some more some less, according to the steepness of the hill, for their Vineyards generally grow upon the sides of hills and mountains. The branches of the Vines, when grown long enough, they throw over the poles and fasten them; they trim them and nip off the ends of the branches according to art, and in the be-

The Portuguese method of cultivating Vines.

ginning of autumn, they cut away the lateral branches and nephews at different times and by degrees pluck away all superfluous leaves, so that the fruit becomes much exposed to the sun, the air and winds, that they may arrive at full maturity. They then gather them, take away all the rotten and unripe fruit, throw them into the vat and tread them lustily, singing all the while some Bachanalian songs, according to the Portuguese dulness; and when they are sufficiently trod, they take them out and press them as dry as they can; they then turn the husks into the vat a second time, and although they appear quite dry, yet they trample them over so long that the very husks seem to dissolve into Wine, this they press a second time, and this is laid by for the richest Madeira Wine; which in other countries is dashed with water and made into a thin Wine for common use.

Of dung-
ing vine-
yards.

If you mean to have plenty of Grapes, your Vineyard must be well dunged every three years, but hot dung must not be thrown near the stock of the Vine; poor people who cannot come at so great a quantity of dung at a time, may dung one third of their Vineyard every year; I shall now take notice of the different soils and dungs that are best and fit for Vineyards; a Vineyard planted on a piece of good strong new ground needs no dung the first seven years. The best manure for a Vineyard is such as is warm and free from grass seeds, for grass is a great enemy to Vines: Fowl's dung of every kind, except water fowl; soap ashes, or other ashes sprinkled thinly between the rows of Vines but not too near them, for this manure is very hot and sharp, and is best spread on the ground in the fall, that it may mix with the soil and be properly tempered before the heat of the next summer comes on, otherwise it would burn up the plants, the rich soil that is washed down and settles along the sides of brooks and rivers and in many low places along roads and highways, which poor and industrious people may easily come at; sea sand, mixed with common soil that might be taken up along the highways, would make an excellent manure; in short, sand of every kind mixed in large proportions with good soil, is very comforting to Vines, for those Vines produce the sweetest and richest Grapes, and

and the strongest and best flavoured Wines, that grow in rich sandy soils : The mortar of old buildings, that has been made of lime and sand, pounded fine ; the dust of charcoal, the small coal and the earth that the coal kilns are covered with when burnt ; the foot of chimneys ; the small cinders and black dirt found about smith's shops, all these are excellent manure for loomy or clay grounds to warm, to open and to dry them, and especially if a large quantity of sand be mixed with it ; creek mud, or the mud along the sides of rivers thrown on in the fall, or thrown up and sweetened all winter and laid on in the spring, is a rich manure for sandy lands, or for clay and loomy lands if mixed with a good quantity of sand. All warm rich untried earth is excellent, so is street dirt of cities. Come we now to what may be for the most part in every farmer's power to procure : And first it will be proper at certain seasons of the year, when the grass is free from seeds to pen his cattle and sheep in some convenient place, where the dung will not wash away, and as near to his Vineyard or house as may be ; into this pen let him throw his straw of all kinds, that is free from grass seeds, his buckwheat straw, chaff and dust, his old salt hay or bog hay ; if he lives near to marshes or salt meadows, let him cut good store of reed, when it is near ripe, thatch, coarse three square and sedge, let it be dried and brought into the pen ; then let him get rich black soil, that settles in low places and the bottom of ponds, that are dry or partly dry in summer, and what settles along the sides of brooks and rivers, and throw these in, let him get good store of leaves of every kind, and throw all the soap suds, chamberlye, the blood of beasts, pork and beef pickle, cyder and beer emptyings, and greasy dish-water, the water that salt meat has been boiled in, all these contribute greatly to make very rich manure.

THE next best method for making good store of manure is to throw most or all of the above materials into a pretty large hog pen ; (if the hogs are fed with red clover, cut green, when it is about two thirds grown, and so on till the seed be grown but not ripe, this mowed twice or three times a day, and given to the hogs is an easy and cheap way of feeding them, and

and will make a rich manure,) hogs will champ with their mouths and trample with their sharp pointed hoofs these materials, and make them fine in a short time, and by rooting, will so tumble and mix them together, that they will soon rot and make good store of manure. Then again, if corn stalks, husks and cobs, such as the cattle do not eat, be thrown into a hollow place, where they may be wet, also the chaff of flax-feed, the shives and hurls of flax and hemp, where they will rot in a year's time, these make a good manure. Here let me remark, without giving offence to my dear countrymen, whose good I have always studied, and whose interest I would willingly promote, that with a little more industry and application, and some easy and proper contrivances, take the whole country in general, I am pretty certain, that ten times the manure might be made and saved, that is made at present, and how much our old lands stand in need of it; every farmer very well knows; and give me leave farther to assert, that where a man has it in his power, and can employ a hand and team altogether in cutting and bringing together as many of the above materials, as can conveniently be had, at the year's end, he would find him by much the most profitable employed of any man and team upon his plantation: For I am clearly of opinion that, ten acres of land well manured, will produce a much greater profit to the owner than forty acres of common old lands as they are now managed; the whole charge of manuring, tilling, and of the seed for sowing, together with the fencing, reaping, threshing, &c. being fairly calculated. For the ten acres will produce four good crops successively, one of barley, then one of wheat, the next of oats, and the last of rye; and with a sprinkling of dug, it may be laid down with red clover: The charge of ploughing for these four crops, amounts to no more than the charge for ploughing the forty acres for one crop, the expence of fencing the latter is much greater: The forty acres in the common way of working, lies fallow for three summers, and generally yields but very little grass, the fourth summer it is ploughed again and yields no grass at all; whereas on the plan proposed, the ten acres in the fall after the wheat and the rye will yield plenty of grass. Pardon this digression, I hope it will not be altogether unprofitable.

GRAPES

GRAPES are a delicious fruit and very tempting to people of every age and sex, the rude and unthinking sort will take all advantages of your absence or neglect at the time of the fruit's beginning to grow ripe, to rob and pilfer; such therefore must be carefully guarded against, by a good close high fence without, and a smart watchful dog within, and especially by the Vigneron's appearing now and then with a gun in his hand walking about his Vineyard in an evening, particularly when there are idle people without; this will effectually prevent any attempts, when they see what they apprehend to be so very dangerous.

Of guard-
ing a
vineyard
from
boys.

BUT these are not the only enemies we have to fear and guard against, there are others which appear less formidable, and yet are full as destructive, namely birds: The Robins are very numerous, and devour abundance of Grapes; the best and most effectual method I ever discovered to get rid of these, was to destroy their food, that ripens about the time that the Grapes do, which consists of wild cherries and poke-berries chiefly; there are other small berries which Robins feed upon, but they chiefly grow in swamp and wet places, which are now generally cleared and destroyed. One year I cut down all the wild cherry trees on my plantation, and rooted up all the poke bushes, and not a robin appeared near my Vineyard till all my Grapes were ripe and gathered; more than that, in order to save my English cherries, I made my boys go through my orchard twice when the robins had laid their eggs, and pull down their nests, by this means they hatched their young so late, at which time they take away the fruit, that I saved my crop of cherries. The Cat-bird and the Thrush are not so numerous, and therefore they are apt to be overlooked, and especially as they give you a fine song for your fruit; but they are both sly, cunning and very artful thieves, and devour Grapes in great abundance, nothing that I have yet discovered, but a good gunner, will get the better of these: But then again Wasps are great enemies to Grapes, they pierce them in several places, with their sharp pointed bills, and that the fairest, ripest and most forward Grapes, which make the best Wine, these rot or dry away, which is a great loss to the owner; the best way I have

From birds.

From
wasps.

have yet met with, to destroy these pernicious vermin, is to hang up phials here and there, along the outward rows of Vines, filled half full of water well sweetened with honey, molasses, or coarse black sugar, the mouth of the phial must be so wide as easily to receive a wasp into it, and not much wider, the wasps soon find out the molasses by its scent, and getting into the phial, are drowned in the sweetened water; another way I have discovered, which comes very near to the former, if it does not exceed it, which is to cover flat wide earthen pans, all over the bottom with honey or molasses without water, if there be three or four of these pans placed at a good distance, the whole length of the Vineyard every wasp to leeward, that is within smell of them, will come to the feast, they will soon so entangle themselves in the molasses that, if you attend them, you may make it a deadly feast to almost all that come; when the wind comes from another quarter, place your pans along another part or side of your Vineyard, that so the wind may blow from the Vineyard to the place, from whence you would draw the wasps, and so go round till you have destroyed them all.

ONE circumstance I have omitted with regard to birds, and that is, if poles be stuck up here and there, near that quarter where the birds harbour and have their haunt, and small branches with three or four twigs on them, be fastened to the top of the pole, and the twigs well daubed over with bird-lime, the birds will readily perch upon them, and will be so entangled by the bird-lime that if they are suffered to continue upon them some time, if they then get away, they will hardly return again that season: and as if they could communicate to each other their grievances and their dangers, few or none of the same species will come into the Vineyard that season.

THE same grub, which is a short smooth earth worm, that cuts off the English beans, &c. is very hurtful to young Vines, often cuts off the choicest branches; if the earth were taken away round the foot of the Vine, about two inches down, and some tar and hog's lard, mixed in equal quantities, were

were daubed round that part of the Vine, I think, though I never have made the experiment, it would prevent the mischief.

VINE Fretters also are often injurious to Vines; they are very small animalculæ, or insects, of what species, I have never examined, but they appear in great numbers, in mere clusters, upon the young tender branches, upon the juice of which they feed; the only remedy I know, is to take away the branch with them upon it, and so destroy them bodily; but if the branch cannot be spared, they must be mashed and rubbed off by a careful tender hand; if they are chiefly destroyed the first two or three years, they are not so numerous nor so troublesome afterward.

It is common with Gardeners and Vignerons, who cannot bear to see a good piece of ground lie idle, to raise a crop of cabbages, colliflowers or brocoli, between Vines when young. This is very wrong and very injurious to Vineyards; for it not only cramps the growth of the Vines, but robs the soil of those rich salts and sulphureous oils, which are necessary to bring the fruit to perfection when the Vines begin to bear. The soil cannot be too fresh for a Vineyard, provided it be not too rank, and therefore a fresh new soil, that has never been ploughed, at least not in many years, is always recommended as most proper for a Vineyard. A clean, light, warm, rich soil, that has a great mixture of sand is best; a rank, heavy, stubborn soil is not good, it is apt to rot the Vines, unless it lies high along the south and south-east sides of hills and mountains, the dryness of the situation and the intense heat of the sun greatly alter such a soil, and meliorate it, they open, warm and sweeten it, by drawing out its cold sour bitter nature, and render it fit for the richest productions, so that here the strongest and highest flavoured Wines are made.

Nothing
should be
planted
among
vines.

I HAVE already mentioned the planting of Vines at a proper distance, and in this I have exceeded the common distance practised in most Wine countries; and that for reasons which I shall presently assign.

Reasons
for plant-
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at the dis-
tance of
8 feet.

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WHEN

WHEN I first undertook a Vineyard, I can without the least spark of vanity say, I did it for the good of my country, and from a principle of love to mankind; I considered that too many of the people of America were unhappily drawn into great excesses in the use of distilled spirituous liquors, which ruin their constitutions, and soon render them unfit for the service of God and their country, as well as for that of their own family and friends. Wine on the contrary is a more homogeneous liquor, more wholesome and much better adapted to the spirit and constitution of man; and although men will run into excesses in the use of it, yet it works itself off better, and does not destroy the natural vital heat and animal spirits, in so great a degree and in so sudden a manner, as fiery distilled liquors do; for these reasons I went on, and endeavoured to make myself master of the subject, and by many experiments to satisfy myself of the truth of things. I was determined not to take up with things upon trust; for these things are generally conducted according to the usage and custom of our forefathers, whose method we follow with the same implicit faith, that too many do the religious tenets, customs and worship of their church, without examining into the nature, reasonableness and soundness of them: But as reasonable creatures and free agents, I think, we have a right to examine things, to search into the nature and reason of them, and to judge and act for ourselves; and ought not to be tied down to arbitrary rules and rigid customs which have been laid down and established in times of ignorance and superstition. To assume then a perfect liberty in planting of Vineyards and making of Wines, as well as in all other parts of husbandry, I shall now proceed to give such reasons for planting Vines at a distance, as are obvious and clear to me from several experiments which I have made. If a Vineyard lies on a sloping ground and is not too steep to plough, the Vines should be planted eight feet from each other every way; the advantages of this manner of planting I think are many; with a single horse plough, having a foot fixed in the fore part of the beam, by way of gage, to prevent the plough from going so deep as to cut the roots of the Vines; a man with the help of a careful boy to ride and guide the horse, the horse always

Advantages of
ploughing.

always supposed to be tame and under good government, may plough a full acre or more in a day, which is as much as six men will generally dig up with hoes, and is every way much better done, the furrows lying across the descending ground, will very much prevent washing away by hard rains; the ground lies light hollow and loose, by which means it readily receives all the benefit of the atmosphere, the dews, the winds and night air, the mists and soft descending rains, which meliorate and impregnate it with nitre, volatile and fixed salts, and with oily and sulphureous matter, fit for vegetation and the richest productions, and the sun more effectually draws out the sour and bitter nature of the soil, and by its genial heat prepares it for a plentiful production. After this it requires no more culture for twelve or fourteen days time, or more, according to the weather. If a drought succeeds the ploughing, it will need no other stirring till rain comes, provided the ground turned up mellow and crumbly, which it will do if it was not wet when it was ploughed, which a judicious farmer will at all times carefully avoid, for nothing hurts a crop of any kind more than ploughing or harrowing ground when it is wet; Columella says, that it renders the ground carious, and that it will not recover a proper temper again that season, and this I once found by woful experience, which effectually cured me of stirring ground when wet, for any culture whatever. I say, that the ground will not want stirring again till rain comes, unless by the help of great dews the weeds should appear, it must then be harrowed with a sharp iron tooth harrow; which the same man, boy and horse can manage; the man if careful and diligent, can with ease harrow three acres a day, and if this be repeated three, four or five days, after every rain, or upon the first appearance of weeds, they may with great ease be kept down: All then that is to be done with the hoe is, to keep the rows between the ploughings free from grass and weeds, which are soon run over and the ground kept loose and light, so as to let in the air, which is of great service to Vines; and the more mellow your ground the better it stands a drought; when the Vines stand too near, the work must be done altogether by hand; this requires many more hands, which is very expensive, the work is tedious and al-

most endless ; the careless hard working man often strikes too deep and wounds or cuts off the roots, the lazy and indolent will not strike deep enough, besides, they all must trample down good part of what they dig, so that the ground cannot be left so loose and light as by ploughing. Again, when the rows are at a good distance, the Vines will not interlock nor shade one another, which is very pernicious, the wind and air will pass freely through them, which are very refreshing, and greatly help forward the growth, ripeness, and sweetness of the fruit ; then the morning Sun, which is comforting and vivifying, will have free access to every plant, will warm the ground, which grows cold by the absence of the Sun, and by the night air ; all will lie fairly open to the more exalted meridian Sun, which by its heat brings forward the fruit to full maturity. Again, when the rows are at a proper distance each way, the roots of the Vines will not so greatly interfere with each other ; they will have more room to spread and extend themselves, and collect more nourishment and food for themselves and their offspring. Vines of four and five years old extend their roots six and eight feet from their stocks ; as for the root that shoots downward, nature, for the preservation of the plant from excessive droughts, darts them down so far as to reach a moisture below sufficient to secure them from perishing. If then in four or five years they extend their roots so far, how must they interfere and rob each other, when they are planted near, and especially when they grow old, their roots then are so interwoven that they appear like a piece of net work ; this, I think, shews, and plainly proves, that Vines planted three, four, five, or even six feet apart, are quite too near, so that they greatly hurt each other and cannot produce so good Wine. Again, when Vines are planted at a proper distance, a wheel or a hand barrow may pass freely through them, which will greatly facilitate the dunging of the ground and the gathering in of the Vintage ; or a horse with panniers on each side, made flat on the side next his body, or a long square basket fixed on a hand-barrow and slung across two hardy boys shoulders, would give dispatch to either work. But farther, men of learning and observation say, that Vines planted at a distance produce the best and richest Wines, and to crown all, it is the opinion of
of

of men knowing and experienced in these things, that a Vineyard planted at eight or ten feet distance each way, will produce as many Grapes, as one planted within half that distance, though there be twice as many Vines; that it will produce larger and finer Grapes; will bring its fruit to greater perfection, and make better Wine.



If a man be poor and cannot procure a horse and a plough, or if his Vineyard be small and he chooses to cultivate it with his own hands, or if his Vineyard lies along the side of a steep hill or mountain and cannot be ploughed, in either case the German double pick, or farkling iron, is the best instrument for digging a Vineyard; the shape you have in the margin: This instrument digs the ground with more ease than the hoe, and neither cuts nor wounds the roots. It is fixed on the handle like a hoe, and bends downward as that does.

As stakes are a necessary article, and as on the choice of them depends very much their durableness, I shall mention some sorts that are most likely to last and do the greatest service. Red cedar, locust, mulberry, thrifty chesnut, that is free from worm holes, sassafras, or the heart of oak, the heart of yellow pine, such as grow in New-Jersey in dry sandy grounds, I am told will last long in some grounds. The stakes must be about an inch and a quarter square, and not less, the biggest end must be sharpened, they stand the firmer in the ground; if both ends were dipped in boiling tar, the head not above two inches, the lower end so deep as that the tar may appear above ground when the stake is drove down firm, this will greatly help to preserve the stakes from rotting; the best way to save your stakes from being battered to pieces by driving is, to have a spike, with a long tapering socket, an inch and an half bore at top, with a long taper point, well steeled; the whole about fourteen inches long, with a staff fixed in the socket four feet long, the whole shaped as in the margin:

Proper
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margin: With this the holes for the stakes are made a foot deep, and with a stroke or two of a mallet, the stakes are firmly fixed, without being split or battered. The stakes should be six feet long, so as to stand five feet out of the ground, and should be drove by a line and stand strait.

THE Roman frame, which served instead of espaliers in ancient times was plain, cheap and frugal, fit for farmers, and such as every farmer can find, on his own plantation, without any other expence besides his own labour: This shews the oeconomy and prudence of that great and wise nation, whilst they were a common wealth. It consisted of strong stakes or small posts fixed well in the ground in a strait line six feet high, and three rows of poles tied fast to them one above another, and fifteen inches apart, the upper pole being four, five, or six feet from the ground, according to the age of the Vine, over the upper pole the bearing branches were laid, looking toward the south, and were fastened to the pole, and this they called precipitating a Vine, when the branches were grown long enough, they were fastened to the middle pole, and then to the lowermost, and when they came near the ground they were cut off. The branches were regularly disposed so as each might have the benefit of the Sun and air, by being fastened to stakes drove down here and there, along the frame; they were trimmed and managed in other respects, just in the same manner as those directed for espaliers; and indeed from these frames the espalier was taken.

Materials
for bands.

THE materials proper to make bands of, to bind the Vines to the stakes are, the sweet flag, otherwise called the Calamus Aromaticus. These long flat leaves cut in June and dried in the shade, and then bundled up and kept in a dry place for use do very well, but then they must be made wet when you bind with them. The long flat leaves of reed, the rushes and three square that grow in marshy or meadow ground preserved and used in the same manner do as well.

Of gather-
ing the
vintage.

HAVING now gone through the necessary directions for planting and managing Vines for Vineyards, I proceed to the making

making of Wine, a subject though short and easy, yet calls for great nicety and exactness. The making, fermenting and preserving of Wine is a mystery to the people of America, but when the methods of managing these things are brought to light and explained nothing appears more simple and easy; but before I proceed to this work, it will be necessary to give some directions about gathering the Grapes, since that work must be done before we can make Wine. As my countrymen are generally strangers to all these things, I hope they will bear with me, if sometimes I am more particular than to some it may seem necessary; since I would willingly remove every obstacle out of the way, and communicate every the most minute circumstance to those, who are altogether strangers to this new undertaking in America, so that any man of common sense, that can read, may safely undertake and go through with the whole affair successfully.

I HAVE already observed, that the black Grapes differ from the white in the manner of ripening, but whether your Grapes be black or white, they must be fully ripe before they are gathered, otherwise they will not make good Wine; gather them in a fair day, when they are perfectly dry; take away all the rotten and unripe Grapes from every cluster, for they spoil the Wine: If your Vintage be large and you gather more Grapes than you can mash and press out in one day, let them be gathered without bruising, for bruised Grapes soon contract an unsavory taste and hurt the Wine in proportion; if they are mashed the same day they are gathered, the bruising will do no hurt; nevertheless I would advise the gathering of them to be directed by some grave discreet person, for as this work is done generally by servants and children, it is made matter of pastime and frolic, rather than prudent labour, and so many Grapes are torn off, and either bruised or scattered on the ground, to the no small damage of the owner, both in the loss of fruit, and in hurting the Wine, and these things should be impressed on the minds of the gatherers before they begin, that every thing may be done regularly and in order, by which means more work will be done, and to much better purpose.

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THE black Grapes are best known to be ripe, when here and there one of the forwardest Grapes begins to shrivel and dry ; then set to and gather and make them up into Wine as fast as you can.

If white frosts happen before some of your Grapes are fully ripe though very near it, so as to want no farther feeding, you need be under no apprehensions about them, let them still hang on the Vines, they will grow ripe, rich and high flavoured notwithstanding ; but then they must be gathered before the weather be so hard as to freeze the Grapes, for that will spoil them ; the light frosts that only kill the leaves do not hurt the fruit, unless it be such as are late ripe, these should be carefully covered from all frosts, they should grow against walls or board fences fronting the south or south-east, and at night be covered with mats or frames thatched with straw, which should be so contrived as to be set up to cover the fruit or let down at pleasure.

A PRETTY good judgement may be formed of the goodness or badness of your Wine, and of a plentiful or thin Vintage, by the seasons of the year ; if the spring and former part of the summer prove generally dry, with now and then moderate refreshing rains, if the season in August and September be hot and dry, if in the month of June the weather be calm, serene and dry, when the Vine is in blossom, and the fruit is forming, your crop or Vintage will be plentiful, and your Wine rich and good : But if at the time of blossoming, the season be wet and stormy, the winds high and blustering, if the spring be cold with much wet, and backward, if the latter part of summer and fall be stormy, raw and wet ; your crop will be thin, and the Wine small and bad ; when this happens, it will be necessary and for your advantage, to boil one half of the must, and to manage it as I shall hereafter direct you.

Method of making wine of the white grape. As the Wine made from black Grapes has a different management from that made of white Grapes, I shall begin with the white ; these then must be gathered as I mentioned before in a fair day, when the Grapes are perfectly dry ; and both the

rotten and unripe Grapes being carefully plucked off from every bunch, the clusters are then thrown into the mash vat, and two or three men, according to the quantity, having washed their feet and legs very clean in bran and water, get into the vat and trample and mash the Grapes thoroughly so that none escape, the more they are trampled and mashed the better; about Paris they let the murk, that is the skins, stalks, must and all stand together in the vat eight and forty hours and then press it off, but in other parts of France they press off as soon as the Grapes are mashed: The last method I should prefer, provided the husks be trod over again in the Portuguese manner, otherwise I should prefer the first method practised by the people about Paris, for this reason, because there is a rich pulp that adheres to the skin of the Grape, which is not separated by the first treading; but by lying eight and forty hours in the murk, and the vat covered with sheets or blankets, which is the practice, a pretty strong fermentation has begun and continued some time, which partly dissolves and partly loosens this rich pulp, that stuck to the skin, which then chiefly comes away by pressing; however I am of opinion that, the treading of these husks after the fermentation, the must having first run off into the receiver, would do the work more effectually if they were well pressed after it. But then we must take this caution along with us, that if Vines are young, which always afford a thin weak Wine, or if the seasons have been wet and bad, so that the juices are not rich, in those cases the must should be boiled before any fermentation, in order to preserve the Wine (as I shall farther direct you when we come to the boiling of Wines) in that case the Portuguese method must be pursued, because the boiling of Wine after the fermentation has begun, would entirely spoil it; the sweet must only, as it runs from the treading into the receiver, must be boiled. The first and second pressing being mixed together is put into hogsheds, which must be filled within four inches of the bung, that it may have room to work and ferment, the casks being placed in some warm room or dry cellar. Then having a small spile fixed in the middle of the head of the cask, the third or fourth day, draw a little of the Wine in a glass, and if it be pretty fine, draw

it off immediately into a clean dry well scented cask, the larger the better, so you have Wine enough to fill it, which you must do within two inches of the bung, and stop it close, leaving only the vent hole open for a second fermentation; after a few days it will work a second time, but not so much as at the first; if your Wine be strong and good, which you may know by the age of your Vineyard, and by the goodness of the seasons, it will be best to leave the bung hole open for this second working, the Wine will be the better: for strong Wines require a greater fermentation than weak Wines, and the stopping of the bung hole, is a check upon the working, and prevents weak Vines from spending themselves too much, which must greatly hurt them; on the contrary if strong Wines have not a thorough working, they are apt to grow thick and ropy, which hurts them as much the otherway; by this you may form a proper judgment what degree of fermentation is proper for the Wine that is under working and govern yourself accordingly. Three or four days after the second fermentation begins, which you must carefully watch by visiting your Wines every day, again try your Wine in a glass, and if it be pretty fine, prepare a cask sweet and good, burn a good large brimstone match in it, and as soon as the match is burnt out, whilst the cask is full of smoke, draw off the Wine into it; now fill up your cask to the brim, and bung it up tight and stop the vent hole; the smoke of the brimstone will hinder any further fermentation; and this is called stumming: then make a mortar of clay and horse dung mixed up with strong flaxseed tea, and cover the bung and vent hole close with it, and so let it stand till it is fit to sell or to use.

WHEN you first rack off your Wine, if you have any old Wine that is rich and good, of the same kind or colour, put four or six gallons of it, and two gallons of good brandy into your cask (this quantity is sufficient for an English hoghead) and then rack off your Wine into it for the first time, this will greatly strengthen and preserve your Wine, and if your Wine be weak, it will hinder too great a fermentation the second time, and so preserve the purer spirits from flying off.

WHEN.

WHEN Wine is in fermentation, all the gross parts are thrown up to the top of the cask, or vessel that it ferments in, and there meeting the air, they undergo a very great change for the worse, they contract a harshness and become rancid. If then they are suffered to pass down through the body of the Wine, which they certainly will do, as soon as the fermentation is over, they will communicate those evil qualities to the Wine, and it must be a strong Wine indeed that will stand such a shock. If the Wine be weak it will soon turn sour; if the Wine be strong and has a sufficient stock of native spirits to defend it from those bad impressions, yet it will contract an unfavourable harshness, which will not be removed for some time, nor will it be fit for drinking till age has smoothed and made it mellow. For this reason it is that you are to draw off your Wine both times before the fermentation be quite over, and as to weak Wines, they should by no means work too much, either time, three days are quite sufficient for each working; strong Wines should work longer for the reason above assigned, they are better able to stand it, besides it prevents ropiness and they fine the sooner and better for it.

I now pass on to the making of red Wines from the black Grapes. Red Wines have a different management from the White; the whole of one or even two days treading or mashing, (where the Vintage is great) is thrown into a large vat, the must, stalks, skins and all, and stands in some warm dry place or cellar. The vat is covered close with sheets or blankets, or both, and thus it remains, according to custom from four to seven or even ten days, according to the coldness or heat of the weather. This is done to obtain a strong fermentation, in order to give a deeper colour to the Wine, and this is the only end proposed by it; the manager of this work, visits the vat twice a day, and in a glass views the colour of the Wine, and tastes it; if the tincture be not deep enough to his mind, he knows by the taste of the Wine, whether it will stand a longer fermentation: if it will not, he contents himself with the colour it has, and draws and presses it off, and fills it into casks, leaving about two inches from the bung, for a second fermentation. When the second fermentation is over,

Method of
making
red wine.

which generally happens in four or five days, he then draws it off into clean well scented casks, and adds to it six gallons of good old Wine and two gallons of brandy to an English hoghead, which contains from 60 to 63 gallons. Where the same kind of Wine is not to be had, he makes use of Port Wine. He then fills the cask quite full and bungs it up tight, leaving only the vent hole open to let out the generated air. Note, when I say, where the same kind of Wine is not to be had he makes use of Portugal Wines, this is mentioned for our practice, not that the French make use of such Wines, for they always have Wines enough of their own of the same kind.

THIS management of red Wines, which perhaps with little variation, is almost as antient as the making of Wine in France, deserves some attention and a close examination, in as much as I am fully persuaded that it is capable of an essential improvement.

To understand the nature of this affair rightly, we must know that, besides the main pulp or core of the Grape, which is white in black Grapes as well as others, there sticks to the inside of the skin, a considerable body of rich pulp, which is perfectly red, of a deeper die in some than in others. This pulp gives the colour to the Grape, according to the lightness or deepness of its tincture: thus we see some Grapes of a light red, some of a full red and some of a deep red, some again are almost black, some quite black and some of a shining jett; this same pulp also gives the tincture or colour to the Wine, for the same Grape is capable of making white Wine as well as red Wine; if the main core which is first trod out, be only used, the Wine will be white; thus they make white Burgundy, &c. but if the red pulp be mixed with it, it makes it of a rich purple colour; as this is a clear case and lies exposed to every discerning eye, the great point of improvement to be gained, is, to dissolve or extract this rich pulp, without injuring the Wine. That the present method is the best and most effectual to that purpose, I can by no means think; the violent fermentation through which the Wine is made to pass,
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in order to procure the tincture, must exhaust the spirits in a very great degree, and leave the body in a weak and languid state, and subject it to harshness, to turn eager or vapid in a short time; these Wines grow worse not better by age; many instances of this kind we meet with in the French Clarets, among which, where one hogshead proves good, sound and wholesome, ten, not to say twenty, prove harsh, eager and disagreeable: These considerations lead me to think, that the present management calls loudly for a reformation; one experiment I have made, and but one, which I shall offer with some farther thoughts to consideration for farther improvement; but I most heartily recommend this affair to some public spirited and worthy philosophers of the age, who by repeated experiments might bring to light this important secret, which when known would be very beneficial to the nation. The experiment I made was this, in a clean stone pot, wide and open, containing two gallons, I squeezed as many Burgundy Grapes as nearly filled it, with the liquor and skins; the stalks I left out. It stood in a dry room covered with a coarse dry towel four double, four days and nights fermenting, I then strained it off and with my hands mashed the skins very well, by this means I obtained a full deep tincture of that kind of purple that is peculiar to the Burgundy Wine; I then left it to ferment, in a large case bottle, after the first and second fermentations were over, I found about a quart of rich sediment at the bottom and a pretty thick skin formed on the top, the smell was very pleasant and truly Vinous, the just indications of a sound healthy Wine. By this experiment I found that, three days fermentation, allowing the first day for heating, which is preparatory to fermentation, (the degrees of heat are mentioned by Boerhaave, Hoffman and others) was sufficient to obtain a tincture, with the help of squeezing the skins a second time, without injuring the Wine, and I found what red pulp remained adhering to the skins, separated from them very easily, and by the colour of the Wine, before the second squeezing, that the fermentation had dissolved most of this pulp, or extracted a great part of its tincture; from the whole then, I think I have reason to conclude, that if the husks or skins, after four days lying in the murk, were taken out.

out and thrown into the mash vat, and heartily trod over again, and especially if some of the must, or rather Wine, for it is Wine after fermentation, be now and then thrown over the husks, as they are trampling it in order to wash away the pulp, that a full tincture may be obtained, without torturing the Wine, as the present manner is, and without running so great a risque of spoiling it.

As this is a very important point, upon the right management of which depends the goodness of the Wine, and as a farther improvement is hereby designed, I have dwelt the longer upon the subject, and therefore hope it will not be looked upon, as a useless digression.

Method of improving weak wines. WINE made from young Vineyards is always thin and weak, and so are Wines from old Vineyards, when the seasons have been cold, stormy and wet, and without some assistance, they will not hold sound long; now this is given two ways, either by the help of some old strong Wine, one fourth part at least, and four gallons of brandy to an English hogshead, or if that is not in your power, then half of the must is to be boiled away to one half of its quantity, that is, if one half of your must contains forty gallons, that must be boiled away to twenty, this greatly enriches it, and makes it of the consistence of liquid honey. As soon as it is cool, mix it with the rest of the must, and let it ferment together, and then manage it as before directed of other Wines; when your Vineyard comes to be ten or twelve years old, it will yield much stronger Wines.

Manner of boiling must. THE boiling of your must is managed in the following manner, which must be carefully attended to; your copper or kettle being well cleaned, rub the inside all over with a woollen rag dipped in sweet oil, which preserves the Wine from contracting a nauseous, copper or brass taste; then throw in your must, and kindle a gentle fire under the copper with brush or small split wood, your copper standing so high, that the wood need not touch the bottom of it, when you put large wood under it to make it boil fast; for if at any time your wood touches the bottom of your kettle or copper, the Wine will

will be burned, which will spoil it ; as the scum rises skim it off, and gently raise your fire by slow degrees, stirring your must often from the bottom, and take off the scum as it rises, till all be clear, then raise your fire by larger wood, and make it boil faster and faster, as it settles down or boils away, till one half be consumed, being always careful and upon the watch that none of the wood touches the bottom of the copper ; the must thus boiled away is called defrutum, or the rob of Grapes. If you neglect to raise the sediment from the bottom of the copper, it will burn and spoil the Wine, for it turns bitter.

AND now once for all I must caution every one, who attempts to make Wine, to be strictly careful to have all the vessels and instruments made use of in this work, perfectly clean and sweet ; for if they have any sour, unsavoury or offensive smell, they will communicate it to the must and spoil the Wine ; and every thing that has an offensive or disagreeable smell, must be removed from the place where Wine is made, and from the cellars where it is kept ; the cellar ought to be dry and warm, for damps or wet hurt Wines exceedingly. It must also be free from mustiness, and in good weather, the windows next the south and west must be opened, to admit the warm dry air, which will prevent mustiness and dangerous damps.

HOGSHEADS well bound with iron are the only safe casks for Wine, if you trust to old wine pipes, or to hogsheads with wooden hoops, it is ten to one but they deceive you ; they constantly want repairing every year, but iron bound casks will hold many years without any expence at all, so that in three years time they become by much the cheapest casks ; I mean for standing casks, out of which the Wine is racked into other casks for sale ; but then as soon as they are empty, the lees must be taken out and saved for distilling into brandy, and the same day the cask must be filled with water, or else they will be destroyed by a small worm, which will pierce it like a five.

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EVERY man that has a Vineyard should have a still and good worm, that he may distill all the lees, the husks and the scum into good brandy, which he will want for the preservation of his Wines; the same still will do to make peach brandy and the spirits of cyder, which will soon pay for it. A still that holds a barrel is quite large enough, unless your Vineyard and orchards be very large indeed.

I now pass on to the different management of Wine after fermentation; one method I have already mentioned; some after the second fermentation, leave the Wine in the same cask upon the lees, and adding the old Wine and brandy to it (for which they make room) they stop up the bung hole, and leave only the vent hole open to let out the generated air, till the month of March, filling up the cask from time to time as the Wine subsides or wastes, and then draw it off into a clean, well scented and well stummed cask, and stop all close with mortar.

OTHERS again in the month of March, before they rack it off and stum it, roll the cask backward and forward in the cellar to mix the lees thoroughly with the Wine, thinking thereby to communicate the strength of the lees to the Wine, and then let it stand and settle till it is fine, and rack it off into clean well stummed casks, and stop and plaister all up close.

HERE I think it proper to take notice, that the lees of strong Wines may be of advantage, and communicate some strength to weak Wines, that are racked off upon them, but it does not therefore follow, that all lees are beneficial to the Wines that produce them; for, as I have already observed, the lees, in the time of fermentation, being thrown up to the top of the vessel, there meet with the air, and being exposed to it for four or five days, contract a harsh and rancid nature, if they do not grow quite sour, and then subsiding, as soon as the fermentation is over, and settling to the bottom of the cask, where they are left for the Wine to feed upon, I leave it to any man to judge what kind of food this must be, and what manner of good it can communicate to the Wine. But what shall

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we say, so rigid and arbitrary is custom, that we even look upon it next to rebellion, to deviate or depart from the customs of our fathers. The cyder that has been made in America for above one hundred years past, has till very lately, been constantly spoiled by this same mistake. Every man that makes cyder very well knows, how soon the pumice corrupts and grows sour by being exposed to the air, and yet no man in all that time ever prevented the pumice, after fermentation, from settling down through the whole body of cyder, but there left it to remain for his cyder to feed upon all winter, and indeed all the next summer too, if it lasted so long; with this additional advantage, that in the spring upon a fresh fermentation, the same body of pumice rises again to the top of the cask and there contracts a still greater acidity or rancid nature, and by sinking down again through the body of liquor, communicates a still higher degree of these rare qualities to it, and then the owner complains of the hardness of his cyder, and so does every body else that drinks of it; and yet this has so long remained without a remedy, because our fathers did so.

From what experiments I have made, I am, clearly of opinion that the fæces or lees which are left in wine or cyder is the true cause of their frequent fermentation; nature appears to be loaded with, and sick of them, and like a man with a foul stomach, often strains hard for a discharge, and the neglecting to ease and clear nature of this pernicious, this destructive load, is the chief cause of all the ill effects it produces. In this, the juice of the Grape resembles the blood, the vital juice of man, if by a foul stomach any quantity of crude, indigested or vitiated matter be thrown into the blood, it is presently set into a ferment, which rises and increases till either the matter be fully discharged, or the vital union be dissolved; if the man recovers the shock, and gets the better of the mighty struggle, yet how weak, how low and faint does he appear! Thus it fares with Wines, the strong bodied Wines that are replete with spirits, often get the better of these struggles, but I believe not without considerable loss and damage; but the weaker Wines generally sink under them. It is from this idea of the thing, that I have all along so strongly insisted upon the

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removal of the lees in the beginning, upon the first as well as the second fermentation. I should be greatly pleased if the ingenious and Reverend Dr. Hales, of Teddington in Great-Britain, would, by experiments, bring this matter into a clearer light; the world would be obliged by him, as they have already been, by a discovery which he was so good as to make not long since in a case that bears some relation to the present one; I shall transcribe it as it is related by the ingenious Mr. Philip Miller, in his Gardener's Dictionary: viz. "A great complaint I received from a curious gentlemen in Italy, of the spoiling of their best and finest Wines there; who says, such is the nature of this country Wines in general, (nor are the choicest Chianti's excepted) that at two seasons of the year, viz. the beginning of June and September, the first, when the Grapes are in blossom, and the other when they begin to ripen, some of the best Wines are apt to change, especially at the latter season; not that they turn eager, but take a most unpleasant taste, like that of a rotten Vine leaf, which renders them not only not fit for drinking, but also unfit for vinegar, this is called the Septembrine, and what is most strange, one cask drawn out of the same vat, shall be infected, and another remain perfectly good, and yet both have been kept in the same cellar. As this change happens not to Wine in bottles, though that will turn eager, I am apt to attribute it to some fault in filling the casks, which must always be kept full; which either by letting alone too long, till the decrease be too great, and the scum thereby being too much dilated, is subject to break, or else being broken by filling up the cask, and being mixed with the Wine, gives it that vile taste: But then against this there is a strong objection, i. e. that this defect only seizes the Wine at a particular season, viz. September, over which, if it gets, it will keep good many years: so that the case is worthy the inquiry of naturalists, since it is evident that most Wines are more or less affected with this distemper, during the first year after making.

"UPON receiving this information from Italy, I consulted the Reverend Doctor Hales of Teddington, who was then making several experiments on fermenting liquors, and received from him.

him the curious solution of the cause of this change in Wine, which I sent over to my friend in Italy, who has tried the experiment, and it has accordingly answered his expectation, in preserving the Wine, he thus managed, perfectly good. He has also communicated the experiment to several Vignerons in Italy, who are repeating the same; which take in Doctor Hales's own words, viz.

“FROM many experiments which I made the last summer, I find that all fermented liquors do generate air in large quantities, during the time of their fermentation; for from an experiment made on twelve cubic inches of Malaga raisins, put into eighteen cubic inches of water the beginning of March, there were four hundred and eleven cubic inches of air generated by the middle of April; but afterward, when the fermentation was over, it resorbed a great quantity of this air; and from forty two cubic inches of ale from the ton (which had fermented forty four hours before it was put into the bolt head) there were generated six hundred and thirty nine cubic inches of air from the beginning of March to the middle of June, after which it resorbed thirty two cubic inches of the same air; from whence it is plain that fermented liquors do generate air during the time of their fermentation, but afterwards they are in an imbibing state, which may perhaps account for the alteration in the nice Italian Wines,* for Wine during

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* Had Doctor Hales been asked what he thought was the true cause of those frequent fermentations, and was desired to apply a remedy; I think he would have sought for the cause, where it was to be found, and upon removing that, the effects would naturally have ceased; but being put upon the search of secondary causes, causes far removed from the original, in order to prevent or cure the evil effects of them, he resolved that difficulty, I do suppose in the best manner it could have been done, and with great ingenuity applied a remedy. And now, should these pages fall within his ken, or some friendly letter comprehending my full meaning, the Doctor, as a true Philosopher, from a public benevolent spirit, would soon find out the true cause of these mischiefs, and apply a remedy, truly specific.

The gentleman in Italy, who makes the representation to Mr. Miller says, “And what is most strange, one cask drawn out of the same vat, shall be infected, and another remain perfectly good;” in this case it is certain, that the first and second cask drawn out of the vat, and the third and fourth, if the vat
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the first year after making, continues fermenting more or less, during which time a great quantity of air is generated, until the cold in September puts a stop to it, after which it is in an imbibing state, that is, it draws or sucks in air; the air thus generated is of a rancid nature (as the Grotto del Cáo) and will kill a living animal if put into it, so that if there be, during the fermentation, two quarts of this air, so rancid, pent up in the upper part of the cask, when the cold stops the ferment-

be large, were drawn off fine and clear, being perfectly free from the faces or lees below, but when the last cask comes to be drawn, a good deal of the lees comes with it, and this is not much regarded, as the lees were supposed to nourish the Wine; suppose the gentleman complaining had the first and the last cask drawn out of the vat, and one of them spoiled, the other remained perfectly good, which shall we suppose to have been the cask? That which was perfectly fine, or that which has the lees? Whoever will taste the first and the last drawings, will find so sensible a difference in the Wine, that I think he cannot be at a loss to determine the question.

Secluding the air from Wine or cyder, is a great means of preserving them long sound and good; nature itself points this out to us; Wine forms a scum upon the top to secure itself from the bad impressions of it, and we daily find that these liquors put into bottles, keep much better than when left in casks; some think that strong old Madeira is an exception to this rule, but I think it has not had a fair and impartial trial. That cyder drawn out of a barrel grows worse and worse as the air gets to it, every one is sensible of, whereas some of the same cyder bottled, remains good a long time, if well corked and rofined, as every body knows; and that this is the case with common Wines, no man will dispute. For this reason the lining of the inside of casks with rosin, as the Romans did with pitch, prepared as hereafter directed, would be a great means of preserving Wine, not only from the air but from great waste; and the bung and venthole should be well secured with clay and horse dung: If you are under apprehensions that the rosin will communicate a bad taste to the Wine; melt it, and wash it with lye, and that will prevent it. The Doctor's method of keeping the casks full is very ingenious and of great service.



The Tubes, represented in the margin, perhaps may be a small improvement upon his, this double Tube is supposed to be made of pewter or tin well soldered together; the small Tube enters the large one at bottom, below the Wine, and does not break the scum that is on the top of the Wine in the large Tube; the large Tube should be well stopped with a good close screw head, and this must be opened when Wine is poured in through the small Tube, and presently stopped again, that the cask may always be kept full, and to keep out the air.

fermentation, the Wine by absorbing this air becomes foul, and acquires this rancid taste; to prevent which I would propose the following experiment: Suppose the vessel A filled with Wine, in the bung-hole B of this vessel I would have a glass tube of two feet long and about two inches bore fixed with a pewter socket closely cemented, so that there may be no vacuities on the sides; and in this tube should be another of about



half an inch bore, closely fixed; the lower tube should be always kept about half full of Wine, up to X, which will supply the vessel, as the Wine therein shall waste or subside, so that there will be no room left in the upper part of the vessel to contain generated air, which will pass off through the upper small tube, which must always be left open for that purpose; and the tube being small, there will be no danger of letting in too much air to the Wine: As the Wine in the large tube shall subside, it may be replenished, by introducing a slender funnel through the small tube down to the scum upon the surface of the Wine in the large tube, so as to prevent its being broken by the Wines falling too violently upon it; this will be prevented by the Wines being poured in gently with a small stream. This experiment being tried with glass tubes will give an opportunity to observe, what impression the different states of the air have upon the Wine, by its rising or falling in the tubes; and if it succeeds it may be afterward done by wooden or metal tubes, which will not be so subject to break.

THIS curious experiment having succeeded, where ever it has been tried, will be of great service in the management of Wines; there being many useful hints to be taken from it; particularly with regard to fermenting Wines; for since we find that Wines too long fermented (especially those which are made in cold countries) do seldom keep well; so by letting them stand in a cool place, the fermentation will be checked, which will render the Wines foul, and subject to turn eager; therefore great care should be taken to keep the Wine in an equal temperature of air, which may be known by hanging a thermometer in the vault. But after the Wine has passed its fermentation,

mentation in the vat, and is drawn off into casks, it will require something to feed upon: And when the Wine has remained one year upon the lees it is commonly drawn off into other vessels, it will then also be proper for it to have something to feed upon; about four pounds of the best Malaga raisins picked clean and stoned, and thrown into each hoghead, will be sufficient and best for that purpose, more would be dangerous, by raising a new fermentation, which always hurts the Wine more or less according to the greatness of it. As the Wine will subside by waste as long as it continues in casks, it is the usual method to fill them up from time to time with some Wine, as nearly like the same sort as may be; for if it be of a different nature or much newer, such as has not thoroughly fermented, it will often raise a new fermentation, which will endanger the Wine: Therefore, if you have no such proper Wine, it will be best to throw in as many clean washed pebbles and well dried, as will raise up the Wine to the bung: This I have known practised with success." Thus far Mr. Miller.

HERE I must beg leave to make some observations, which may either serve to throw a light upon this affair, or lay a foundation for farther experiments, in order to come at the truth, which in all cases is worth pursuing, and especially in this, where it has lain dormant for so many ages, and the discovery would be of great importance to the present design.

THE principles of Wine are an inflammable spirit, a phlegm or watery liquor, an acid salt or tartar, and a sulphureous oily substance; Wines therefore greatly differ in their taste, smell and virtue, according to the various proportions and manner in which these principles are combined, Perhaps the difference of flavour, taste, colour, and body in Wines may be owing as much to the time of gathering, manner of pressing, the different degrees of fermentation, &c. as to any difference in the Grapes themselves; in Hungary, whence Tockay and some of the richest and highest flavoured Wines do come, they are extremely curious in these respects; for their prime and most delicate Wines, the Grapes are suffered to continue on the

the Vines till they are half dried by the heat of the Sun; and if the Sun's heat should not prove sufficient, they are dried by the gentle heat of a furnace. Wines that are thin may be improved by freezing, by this means the watery parts adhere to the cask, and the strong spirituous parts are left in a body, in the middle of the cask, and being drawn off by themselves, prove strong and good, and will keep well. See Hoffman, and the celebrated Doctor Sthal on the subject; see also Doctor Shaw's Comment on Sthal.

If these be the real principles, and some of the essential constituent parts of the Grape, or if a proportionable quantity of nitre be allowed to come into the composition, which might perhaps be discovered by an accurate analysis, it will not be hard to account for the fermentation; heat and air both are necessary to it; now these principles whilst confined to the Grape, are so disposed by the wise Author of Nature as to be confined distinctly in their proper cells or tubical ramusculi, and they are so closely secured by the covering of a skin, of such a compact texture, like that of bladders of several kinds, that the air cannot come at them, but they are effectually secured against the impressions of it; if this, or something like this be the case, then these principles remain in a neutral or inactive state, whilst thus confined to the fruit, but when the fruit comes to be mashed, and these principles come in contact of each other, and are exposed to the warm air, which is of a very active and elastic nature, the whole body, by degrees, is put into motion, the motion begets heat, and the heat increases the motion, (this heat and the increase of it is plainly discernable by the touch,) till it increases to such a degree, as according to Boerhaave, is necessary to a full fermentation. The heat then increasing to a farther height, the fermentation, gradually abates, and thus ends the first fermentation: By this operation, a spirit is generated, and the mild, soft, luscious juice of the Grape, which is called must, is changed into a brisk, lively, inflammable spirit, which is then called Wine; which has, if closely and attentively considered, a strange and wonderful effect upon those that drink it, according to their different dispositions, humors and constitutions.

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By the violent motion of this first fermentation, all the faeces or gross parts are thrown up to the top of the vessel, and this is a proper time, at the end of three, four or five days, according to the strength of the Wine, which is then pretty clear, to draw it off from those grosser parts; which will be done without loss, and the lees must be preserved for distilling into brandy. If this be neglected, this gross body having been so long exposed to the air, contracts a rancid nature, or turns sour, and as soon as the fermentation is over, it gradually sinks down to the bottom, and passing slowly through the body of the liquor, communicates those evil qualities to it: This is so clearly discernable in cyder, which also is a tolerable good Wine, when properly managed, that no man can be mistaken in the case. Since I have taken this method with cyder, it has proved more like Wine than common drink, but then I racked it off a second and a third time, as soon as it appeared fine, and then stummed the cask that received it the last time: This cyder will keep sound all summer in a cask, and grows stronger, and may be bottled at any time, it will soon ripen, and be very brisk when poured into a glass, and that without endangering the bottles so much, its briskness proceeding from spirit and not from fermentation.

WEAK Wines will by no means bear so great a fermentation as strong Wines, let them therefore be drawn off after three day's fermentation the first time, and adding two or three gallons of brandy, and five or six gallons of good old Wine; stop up the bung, and leave only the vent-hole open, and when the second fermentation is just over, and when the Wine is pretty fine, draw it off a second time into a well stummed cask, fill it up to the brim, and stop all close, and keep it so till you sell or use it, and then bottle it.

An old Roman method of preserving wine.

SOME customs among the antients, I think, are worthy of notice, and fit to be revived and retained by us; how many of them came to be laid aside, when they appear so useful and beneficial, I cannot say, perhaps for reasons which I am not able to discover: I shall here mention one, which I think pertinent to our present purpose, which was for the preservation of

of their Wines ; they took a firkin, or eight gallons of pure clear tar, of the first cool running from the kiln ; to this they added half as much good clean pitch pounded fine, and put it all into an iron pot, and melted it by a gentle fire ; when hot they put to it four gallons of strong lye (that is a lixivium of ashes,) this they stirred altogether, at least for half an hour very well, it was then left eight and forty hours for the tar and pitch to subside, the lye was then poured off ; the tar and pitch was heated till it melted a second time, and four gallons of fresh lye were poured on, and stirred and managed as before ; this was done a third time ; they then took four gallons of sea water, as salt as could be got, (for people who cannot easily come at the sea water, a good clean brine, made of salt and water, may do as well) the tar and pitch being just melted, but not made too hot, they put the salt water to it, and stirred it very well, this was put in the Sun, and stood open all day, but covered at night to keep off the dews, and when it rained ; this stood exposed to the Sun till all the water was exhaled, and then it was put up for use. With this they payed or daubed over the cask, into which they put the Wine, in this manner : They took out one head of the cask, and in the same manner as our coopers do, they heated the cask thoroughly, and having some of the pitch and tar, (now more resembling pitch alone) melted, they threw in as much as they thought would daub the cask all over, and also the head that was taken out, they then took a broom and rubbed the pitch well over every part of the inside of the cask, so that no spot escaped, turning and winding the cask about very briskly ; for this work must be done in a hurry, least the cask and pitch cool, in which case the pitch grows so thick and hard as to refuse to be spread : By this management of the cask, it was made perfectly tight, all the pores of the wood were stopped, the Wine was preserved from waste, which Wine Merchants very well know is a great saving, and well deserves the trouble and expence, and the spirits of the Wine, which are always active, and striving to fly off through every pore, are greatly preserved, and the air without, which presses hard to insinuate itself through every pore, is effectually prevented. If men that sell rum, or any other spirituous liquors, could

at first afford to have good iron bound casks, for constant standing casks to keep their liquors in, and draw it off as they sell it, they would soon find themselves great gainers by this practice. I think rosin and turpentine well washed with lye in the same manner, would be sweeter, and better answer all the purposes; or indeed rosin alone would do as well.

I SHALL now propose the management of some small quantities, in different manners, by way of experiments, in order, if possible, to arrive at some tolerable perfection in this new undertaking.

1st. LET a keg of four gallons be filled three-fourths with murk, that is, with the must and skins of black Grapes, for making of red Wine, (the skins having been well squeezed) before any fermentation; let the bung hole be stopped close, and leave the vent-hole open, to let out the generated air, and after the second fermentation fill up the keg with old Wine, and let the vent-hole remain open, and let it stand so till February, then draw it off, and manage it as occasion shall require; if it be clear, sweet and good, bottle it, so shall you have a pure genuine Wine with its own peculiar flavour, if you find it thin and weak, you must help it as in other cases.

2d. LET a keg of four gallons be filled with the Wine that is drawn off, after the first fermentation is over, the keg having first been well stummed, stop all close, and let it stand till February, if it then be fine bottle it, if not, stum a second keg well, and draw it off, and stop all close, and let it stand till the next winter, if it then be fine, bottle it; if not, fine it down, and then bottle it for use; If, at the second racking, you find it thin and weak, add some brandy and old Wine to it.

3d. LET white Grapes hang on the Vine a month after the Vintage is over, let others hang till they shrivel, make trial of these at different times; let them be mashed as much as possible without breaking the Grape stones, let them stand in the murk two, three, or four days, well covered with a blanket
three

three or four double, then drain off the Wine, and mash the skins very well over a cullender the second time; then strain out the stones, washing the skins very well with the Wine, till all the pulp, that sticks to the inside of the skins, be got off, fill your keg with this Wine three-fourths, and fill up the rest with good old Wine, stop up the bung, leaving the vent-hole open till the second fermentation is over, then stop the vent-hole, and let it stand till February; I think this Wine will be good; but then in all these cases the vent-hole must now and then be just opened, to let out any generated air, least the keg be in danger of bursting, as soon as the air puffs out stop it again, that as little air as possible, may get in.

By varying these experiments, you may at last come at the most perfect way of making, fermenting, and preserving of Wines; it is now said, that Wines cannot be preserved without brandy, how then did the antients preserve them? I think they may be preserved pure and perfect by their own strength, when a Vineyard comes to a proper age (which I will suppose to begin at twenty, and so last till seventy or eighty;) if the Grapes are suffered to hang on the Vines till they are perfectly ripe; but people partly from a fondness of getting done before their neighbours, and partly from a desire of making a little more Wine, and some from the apprehensions of a rainy season, hurry on this work before its time, and often, very often, become great sufferers by it.

THE reason for my being silent about Vines that are natives of America, is, that I know but little of them, having but just entered upon a trial of them, when my very ill state of health forbid me to proceed: From what little observation I have been able to make, I look upon them to be much more untractable than those of Europe, they will undergo a hard struggle indeed, before they will submit to a low and humble state, a state of abject slavery: They are very hardy and will stand a frame, for they brave the severest storms and winter blasts, they shrink not at snow, ice, hail or rain; the Wine they will make, I imagine from the austerity of their taste, will be strong and masculine.

THE Fox-Grape, whose berries are large and round, is divided into three sorts, the white, the dark red and the black; the berries grow but thin upon the bunches, which are plain without shoulders. They delight most in a rich sandy lome, here they grow very large and the berries are sweetest, but they will grow in any grounds, wet or dry; those that grow on high dry grounds generally become white, and the colour alters to a dark red or black, according to the lowness and wetness of the ground; the situation I think must greatly affect the Wine, in strength, goodness and colour; the berries are generally ripe the beginning of September, and when fully ripe they soon fall away; thus much I have observed as they grow wild. What alteration they may undergo, or how much they may be improved by proper soils and due cultivation I cannot say.

THERE is a small black Grape, a size bigger than the winter Grape, that is ripe in September; it is pleasant to eat, and makes a very pretty Wine, which I have drank of, it was four years old, and seemed to be the better for its age; the colour was amber, owing to the want of knowing how to extract the tincture; this Grape is seldom to be found; there is a Vine of them near John Taylor, Esq; at Middletown, Monmouth, and there are some of them in Mr. Livingston's Vineyard at Piscataqua in New-Jersey. I think they are well worth propagating.

THE frost or winter Grape is known to every body, both the bunches and berries are small, and yield but little juice, but the richness of the Wine may make up for the smallness of the quantity; the taste of the Grape is austere till pretty hard frosts come, and then it takes a favourable turn and becomes very sweet and agreeable; this Vine shoots forth great numbers of slender branches, and might do very well for the south and southeast sides of a summer-house or close walk, if all the useless and barren branches were cut away.

THE Vines of America are fit for strong high espaliers, but if I mistake not, he must watch them narrowly, must take away

away every unnecessary and unprofitable branch, and trim them sharp and close, that means to keep them within bounds.

We see that the Vines of this country have a covering of bark of so close and firm a texture, that they stand all weathers without injury, they fear nothing but a frost after they put forth the tender bud: We see that cold winds and winter blasts have a great effect upon the human body, they brace up and confirm all the solids, harden and strengthen the whole frame, and renders a man active, brisk and lively in all his motions: They have likewise a wonderful effect upon the brute creation; the covering of sheep, cattle and horses, in hot countries, is very thin and cool, remove them into a cold region, sheep soon acquire a covering of wool, horses and cattle a thick coat of hair. Why then should not Vines by being transplanted from a warm into a cold region, acquire a firmness and covering suitable to their new situation? I believe by a proper management they may by degrees be enured to colder countries, but such a hardiness must not be supposed to be acquired all at once, but by being winter after winter, a little more and more exposed to the severities of the weather, they may in a few years, in a great measure, be reconciled to such a climate as ours: But then I would have it remembered that, late ripe fruit will not do as yet to the northward of the capes of Virginia; it is the early ripe fruits that the bread colonies must propagate, till the climate becomes more temperate, by the country's being cleared further back; none that ripen after October will suit us at present, and the latest we raise, should arrive at full maturity by the end of that month. In twenty years I make no doubt November will be as favourable a month as October is now.

The Method of curing GRAPES for RAISINS.

JARR Raisins or Raisins of the sun cured in the most perfect manner, so as to retain their full flavour and keep long without candying is done in the following manner.

BUILD

BUILD a hurdle or stage two feet from the ground, or two feet high, and so long as to hold all the bunches you intend to cure at a time, so as to lie single without touching each other, the bed of the stage is made of split reeds, of willows or any other shrub, that will lie level and smooth, and for want of such it may be made of long rye straw, the ends of which only has been threshed. Then thatch two sides a little longer than the stage, with smooth straw, so close as easily to turn off a shower of rain and yet so light as to be fixed up upon the stage, and to be taken down at pleasure, the ground under the stage must be covered with straw to keep the damp from rising and to reflect heat: this being done prepare a lixivium of ashes, that is, a lye, about half as strong as that you make soap of which bears an egg; this you put into a broad shallow iron kettle, the quantity according to the number of Grapes you intend to cure: Set it a boiling, and throw into it a handful or two of clean salt to four gallons of lye, and one pint of sweet oil, or a pound and half of good sweet butter; then having tyed three or four bunches of the fairest and full ripe Grapes together, taking away the rotten and all the unripe ones, and stirring first the oil or butter very well into the lye, the lye now boiling, you put as many bunches in as will near cover the surface and let them scald pretty well, but not too much so as to be boiled; take them out gently into a wide flat cullender, without bruising, and lay them gently upon the stage, unbind them and lay every bunch single by itself, so as not to touch each other; if your stage be large so that you scald a great many bunches to fill it, and before you have done, or near done, you have reason to believe that your oil or butter is expended, you throw in as much more as you think will finish your quantity, for this adds richness to the Raisins, and preserves them long without candying; if you have hands to hold the bunches by the strings whilst they scald, it would be best, because they would be handled without bruising, and indeed this is the design of tying so many bunches together, but if you are alone or have but one hand with you, and cannot well hold bunches enough to cover the surface of the kettle, the best way would be to cast the bunches in single and to take them out with a slice or a skimmer.

When

When your stage is full, about three hours after you have done, turn the bunches into a dry place on the stage, so that no wet may touch them, and that they may dry as soon as possible; before sun set, at least half an hour, set up your roof and cover them from dews and rain; the next morning as soon as the dews and damps are exhaled, uncover them, and turn them twice that day, and so on till they are pretty moderately dry, so as to be fit for keeping; then put them into jars with covers and plaster them over with clay and horse dung, and set them away in a dry cool place till you use or dispose of them; but beware of damps: and observe that you are to begin this work in the wain of the moon, your Grapes must be fully ripe and taken from the Vines when quite dry. All fruits gathered in the wain of the moon will keep longer sound and good, than those gathered in the increase. Note also that these Raisins thus cured, are fit for princes, for the rich and great, and ought to fetch a good price, since no Raisins can be more delicious. The common Raisins must be scalded the same way, and about the same time, and may be spread upon hurdles laid on straw on the ground, and halled in under some shed or covering at night, before sun set, and brought out in the morning, and when dried put into small casks, such as Raisins come in. The Malaga Grape is esteemed the finest for Raisins, but as the northern colonies, I mean the bread colonies, will not as yet produce them, they being too tender and too late-ripe, we may however be supplied among ourselves from the Red Frontinac, which is a very rich sweet Grape, is early-ripe and makes very good Raisins.

AND now to conclude the whole, as my countrymen are unacquainted with the utensils that are necessary for making of Wine, it is necessary that I say something on that head.

FIRST then according to the size of your Vineyard, you must have a number of cheap crooked knives, the shape of pruning knives, but a little more bending, to cut off the clusters from the Vines; for pulling them off, is very difficult, it is attended with great waste of fruit, and is very destructive to the Vines; you must also have a number of handy baskets:

to put the Grapes into, as you cut them, and also a large wicker basket or pannier, which is of a long square form, fit to place on a good light hand-barrow, with leather strops at each end to hang on the shoulders of two hardy boys, who may trot away with it to the mash vat, as soon as it is full; or else it may be carried in a wheel-barrow, if hands are scarce, or you may have two panniers made fit to hang across a horses back, being made flat on one side for that purpose. Then you will want a mash vat big in proportion to your Vineyard and the age of it, this must have a false bottom full of holes made with a twenty-penny gimblet, but not larger, lest the Grapes get into them, it must lie upon a curve firmly fixed, about six inches above the true bottom; you will also want a receiver, which is a pretty large tub, placed partly under the mash vat, to receive the must as it runs from it; if your Vineyard be large you will also want a kedlar, which is a large vat or ton, for fermenting the murk that you make red Wines of, and perhaps for that of white Wines, if you choose to make Wine of them after the manner of Paris. If your Vineyard be not large the mash vat may answer the purpose. You will also want pails and dippers and a large funnel to ton with: A smart close screw press, to go with one or two screws as you like best, with a wicker frame and hair bag to fit it, and proper followers to press clean and dry, must be had without fail; and last of all good sound strong iron bound butts or hogheads, which are really cheapest and the only casks you can depend upon, what makes them far preferable to others, is, they are always tight, they want no trimming, only a little driving once a year, if they stand empty any time, and they last good for many years, if they are well painted and dried till the smell of the paint goes off, otherwise they would communicate that ill smell to the Wine. And here my dear countrymen I must repeat to you what I have already endeavoured to inculcate, which is, that every thing must be kept sweet and clean; if by carelessness, inattention or hurry of business, you suffer your press or any of your vessels, your tubs or casks to grow sour or musty, they will certainly ruin your Wine, for nothing in nature is sooner tainted than must or new made Wine. And let me persuade you to avoid one great error, which most farmers

farmers run into, about their cyder, least that custom be put in practice also with Wines; they put their cyder into fresh rum hogsheads, under the notion of preserving the cyder strong and good, but they destroy the fine flavour of the apple, and instead of an agreeable vinous liquor, your nose is offended with a strong hogo, and you taste nothing but the fumes of a rum hogshead, so that no gentleman, no man of taste or delicacy, will buy it; now should you make the same mistake with your Wines, you would certainly spoil them, were they otherwise never so good, so that no man would buy them.

It has been the general opinion of mankind that Wines ought to have something to feed upon, but this notion is very wrong, for most things that are put into Wine raise a fermentation in a higher or lower degree; and it is agreed that every after fermentation hurts Wine more or less; if Wine be weak put in brandy and old strong Wine, these are the proper strengtheners and preservers of Wine; strong Wine wants nothing but clean racking, and all Wines should be racked till they are fine. A double handful of clean coarse salt may do good.

PERHAPS I have not said enough upon taking away day roots from Vines the first three or four years of their age, but let me now tell you that, it is of great consequence, and it is the chief means of preventing the Grapes from bursting.

AND now my dear children, countrymen and fellow-citizens, I have faithfully led you by the hand throughout this new undertaking; take my blessing and cordial advice along with it, be not drunken with Wine wherein there is excess, but be ye rather filled with the spirit of wisdom, for too much Wine, like treacherous sin, ruins and destroys the true happiness of the soul. And may the God of wisdom crown all your honest labours with success, and give you a right understanding in all things.

The Method of curing FIGS; by the same Gentleman.

GATHER the fullest and plumpest Figs when ripe and fit to eat, in a dry day, when the dew is off, and in the wain of the moon, spread them on the same hurdle you cure your Raisins upon, turn them twice a day and an hour before sun set cover them from the dew, and from rain: When the Figs are dry, they must be taken from the stage in the middle of a dry clear day, when they are yet warm with the heat of the sun, and put them into earthen jars and press them down flat close, putting a little dried fennel at the bottom and on the top, the cover of the jar must be daubed all round with clay and horse dung and put away in a dry cool place where they will keep the year round sound and good, or may be transported to any place abroad.

OBSERVATIONS *on the raising and dressing of HEMP;*
communicated to the AMERICAN PHILOSOPHICAL SOCIETY,
by EDWARD ANTIL, Esquire.

HEMP is one of the most profitable productions the earth furnishes in northern climates; as it employs a great number of poor people in a very advantageous manner, if its manufacture be carried on properly: It may also furnish a ready remittance to the mother country, and become a reciprocal advantage to both; and therefore it becomes worthy of the serious attention of the different legislatures of the northern colonies, of every trading man, and of every man, who truly loves his country.

BUT as the people of America do not appear, from their present management, to be acquainted with the best and most profitable method of cultivating and managing this valuable plant, I beg leave to inform them of some things that may be of advantage to them.

WHOEVER

WHOEVER would raise Hemp properly and to advantage, should set aside two pieces of ground, of such dimensions each, as he shall be able to cultivate every year, and sow the one whilst he is manuring and preparing the other for the succeeding year's crop; the higher and dryer the ground the better, provided it be well dunged and made strong and mellow; the ground should not be too sloping, least the good soil be washed away with hard rains; if it droops toward the south, so that it may have the full influence of the sun, it will be an advantage; low, rich, warm, dry grounds will also produce good hemp; but wet land, though never so rich will by no means do. The ground being prepared and made very mellow, I now come to that part which must be particularly and exactly attended to, since the success of the crop greatly depends upon it. Sometime in May, the ground being moist and in a vegetating state, but by no means wet, it must be well ploughed, the furrows close and even, the soil lying light and mellow it must be sowed very even with two bushels of seed upon one acre; a man with an iron tooth harrow follows the sower, and harrows in the seed with two horses without any balks, for the less the ground be trampled the better; if harrowing one way be not sufficient to cover the seed, though it would be best if that could be done, it must be cross harrowed. The ground being moist as I said before, but by no means wet so as to clod, which would ruin the crop, the seed will all start and come up together, which is a sure sign of a good crop, and nothing after that, but too much wet, will hurt it; for Hemp thus come up, bids defiance to weeds and grass of every kind; its growth is so quick and it so effectually shades the ground, that nothing below can rise or shew its head, and it so preserves all the moisture below, that the hotter and dryer the weather the faster it grows. Whereas if the seed be sown, when the ground is dry, the seed that lies deepest where the moisture is, will come up first, and these will shade and starve those that come after, by which means the first comers will be too large, and the last will be much too small, so that the crop will be greatly damaged every way: So much depends upon this one circumstance, of sowing the seed when the ground is moist and fit to receive it: The crop thus rightly managed

will stand as thick as very good wheat, and be from four to six feet high, according to the strength of the ground; and the stems will not be thicker than a good wheat straw; by this means the Hemp will be the finer, it will yield the greater quantity, and it may be plucked from the ground like flax, which will be a very great saving: But if it be sowed thin, that is one bushel to an acre, which is the common practice, it grows large, the Hemp is harsh and coarse, and then it must be cut with hooks, which occasions great waste, for four or five inches just above ground is left, by way of stubble, which contains the best and heaviest part of the Hemp.

WHEN the Hemp has got its growth, and is fit to be plucked, which you will know by the under leaves of the carle, or the Hemp, turning yellow and falling off, the sooner it is pulled the better: it must then be bound up with straw bands, in single band sheaves, rather small than large, and each sheaf must be bound in two places; and the sooner it is carried to the water to rot the better: Water rotted Hemp, if it be rightly managed, is every way better than that which is rotted on the ground: there is less waste in it, when it comes to be dressed; it looks brighter and fairer to the eye; it is esteemed to be stronger and more durable, and it always fetches a better price; besides it is much sooner done, and it is rotted more even and alike, and with greater certainty and exactness: Many people in America are acquainted with the method of rotting Hemp in water, but as many more are not yet acquainted with it, I shall, for their information, set down the method of doing it. Hemp may be rotted in stagnated or standing water, such as ponds, pools, or broad deep ditches, and in such water it is generally four or five days and nights a rotting, and sometimes longer, according to the heat or coolness of the weather; it may also be rotted in running water as in a brook or river; and in such water three or four days and nights are sufficient, according to the weather; to know whether the Hemp be rotted enough in either case, take a middling handful, out of the middle row, and try with both your hands to snap it asunder, if it breaks easy, it is rotted enough, but if it yet appears pretty strong, it is not, and must lie

Be longer, till it breaks with ease, and then it must be taken out and dried as soon as possible; in handling the sheaves, take hold of the bands, and set them up an end against a fence, if one be near, or lay them down upon the grass, for the water to drain off, and then unbind them carefully, open and spread them to dry thoroughly; then bind them up again and house them in a dry tight place: the reason of handling the Hemp in this careful manner is, that when it is well rotted, whilst it is wet the lint comes off with the least touch, therefore if it be handled roughly, or if while it is wet it be thrown into a cart and carried to a distance to be unbound and dried, it would be greatly hurt, and the owner would receive great damage by it, but when it is dry, it is handled with safety.

If the Hemp be rotted in a brook or running water, the sheaves must be laid across the stream, for if they be laid down lengthways with the stream, the current of the water will wash away the lint and ruin the Hemp: it must be laid down heads and points, two, four, or six thick, according to the depth of the water and the quantity of Hemp; if the bottom of the river be sand, gravel, or mud, three good strong stakes must be driven down at each end, above and below, and three long strong poles must be laid on the Hemp and fastened well to the stakes, in such manner as to force down the Hemp under water, where it remains till it be rotted enough: though if a muddy stream could be avoided it would be best, because it is apt to foul and stain the Hemp. If the bottom of the stream be rocky or stony, so that stakes cannot be drove down to secure the Hemp under water and from floating away, then a rough wall must be made at the lower end of the Hemp, and along the side, to keep it in, and strong poles or rails must be laid upon the top of the Hemp and pretty heavy stones upon them so as to sink the Hemp under water, where it must lie till it be rotted enough.

WHAT Hemp is intended for seed, should be sowed on a piece of ground by itself, which must be made very rich and strong; it must be sowed in ridges six feet wide, and the seed must be of the largest and best sort and sown very thin, at the rate

rate of a peck upon an acre, or rather six quarts; for the thinner it is sown, the more it branches, and the more seed it bears; it should be sown sometime the middle of April, and then the seed will not be ripe, till sometime after the other Hemp is done with. If you have no convenient place to sow your seed Hemp by itself; then sow a border of six feet wide along the north and west sides of your Hemp field; the reason of sowing your Seed Hemp in such narrow ridges or borders is that, when the carle or he Hemp is ripe, and has shed its farina on the fimble or female Hemp, by which the seed is impregnated, and the leaves of the carle Hemp fall off and the stem grows yellow, you may easily step in along the sides and pull up the carle Hemp without hurting the female, which now begins to branch out, and looks of a deep green colour and very flourishing, and when the seeds begin to ripen, which is known by their falling out of their sockets, you may all along both sides bend down the plants and shake out the seed upon a cloth laid on the ground, for as they ripen they scatter upon being shaken by a hard wind, or otherwise; then it must be watched, and the fowls and yellow birds kept from it, for they are immoderately fond of the seed; as the first ripe seeds are the fullest and best, they are worthy of some pains to save them; and the best way to do that is, to bend down the plants all along, on each side of the border or ridge, as is said above, and shake them over a cloth spread on the ground to receive the seed; if one side of the plant be rooted out of the ground by forcing it down to shake out the seed, there will be no damage, for the seed that remains will ripen notwithstanding; and the plant must thus be shaken every two or three days, till all the seed be ripe and thus saved; and this is much better than pulling up the plants by the roots, and shaking them on a barn floor, and then setting them up against a fence or the side of the barn, for the seed to ripen, and shaking them morning and evening on the barn floor; for by this method, which is the common practice, one third of the seed at least never comes to maturity.

It is well known to every farmer, that in the three bread colonies at least, the spring and summer seasons are of late years become

become very dry; so that a crop of flax is become very precarious, scarcely one year in seven producing a good one: This is a constant complaint in the mouth of every husbandman: Now hemp does not require half the rain that flax does; this is a circumstance that is well worth the notice and attention of every farmer; and therefore by his raising hemp in the manner before directed, and by preparing it in the best manner for spinning and weaving into good cloth, he can with greater certainty supply all the necessary uses of his family; and by selling the overplus, he can purchase such things as his wife and daughters may think convenient on extraordinary occasions. This however need not hinder him from raising some flax every year: But I think that it is more for his interest to fix his chief dependence upon his crop of hemp, as that is more sure, and every way more profitable, the general run of seasons considered. And let him not be disgusted and think that I am about to persuade him, his wife and daughters to wear ozenbrigs, for I can assure him that I have seen dowlafs, which is made of hemp, worth five and six shillings the yard, which no farmer need be ashamed to wear.

I SHALL now endeavour to instruct the honest husbandman in a few easy rules, for preparing his hemp, which he has raised and managed in the manner before directed.

KNOW then that the best preparation of hemp for the manufacturing of cloth is to render it as soft and as fine as possible, without lessening its strength, and the easiest and cheapest way of doing that, is certainly the best. This is to be found out by a variety of trials and experiments; but till a better way be discovered, which I hope will not be long first, and with which I should be greatly pleased; take the following method, which is the best I have yet been able to discover.

If you have a large wide kettle, that will take in your hemp at full length, it will be the better; but if your kettle be small, then you must double your hemp, but without twisting, only the small ends of every hand must be twisted a little, to keep them whole and from tangling; then first of all lay some
smooth.

Smooth sticks down in the bottom of the kettle, so as to lie across one another, three or four layers, according to the bigness and deepness of your kettle; this is to keep the hemp from touching the liquor; then pour some lye of middling strength, half as strong as what you make soap of, gently into the kettle, so much as not to rise up to the top of the sticks, they being kept down to the bottom; then lay in the hemp each layer crossing the other, so that the steem may rise up through the whole body of the hemp, which done, cover your kettle as close as you can, and hang it over a very gentle fire, and keep it simmering or stewing, but not boiling, so as to raise a good steem for six or eight hours; then take it off, and let it stand covered till it be cool enough to handle; then take out the hemp, and wring it very carefully as dry as you well can, and hang it up out of the way of the wind, either in your garret or in your barn, shutting the doors, and there let it remain, turning it now and then till it be perfectly dry; then pack it up in some close dry place, till you want to use it; but you will do well to visit it now and then, least any part of it might be damp and rot. You must know, that wind and air weaken and rot hemp, flax and thread very much. Then at your leisure, twist up some of the hands, as many as you intend for present use as hard as you can, and with a smart round smooth hand beetle, on a smooth stone beat and pound each hand by itself all over very well, turning it round from side to side, till every part be very well bruised; you then untwist it, and hatchel it, first through a coarse, and then through a fine hatchel: And remember that hatcheling must be performed in the same manner, as a man would comb a fine head of hair, he begins at the ends below, and as that untangles, he rises higher, till at last he reaches up to the crown of his head. The first tow makes good ropes for the use of the plantation; the second tow will make very good oznabrigs or coarse sheeting; and the hemp itself will make excellent linen. The same method of steeming softens flax very much.

OBSERVATIONS concerning the FLY-WEEVIL, that destroys the wheat, with some useful discoveries and conclusions, concerning the propagation and progress of that pernicious insect, and the methods to be used to prevent the destruction of the grain by it.

By Colonel LANDON CARTER, of Sabine-Hall, Virginia; transmitted by Colonel LEE. Read, and ordered to be published, November 15th, 1768.

IT is not in my power to oblige you with the paper that I some years ago published in our Gazettes, upon this little destructive insect, called the Moth or Fly-Weevil. However, as you are very earnest in your enquiries as to its particular nature, in order, if possible, to save so beneficial a commodity as wheat to America, which perhaps in a few years (unless such destructive insects do infest it) might become a kind of granary to most parts of Europe; I will from my diaries, put together those discoveries that led me to write that paper; and also what has since occurred to me in the attacks that our country has lately met with from those insects; for it is a certainty they continue amongst us, just as the season favours or not their propagation; although some will fancy they have their periods for coming and going away.

It is but something more than twenty-five years ago, that I heard any thing of such an insect that injured our wheat; but since then I have had frequent occasions to take great notice of it; and have had great reason to be very anxious to examine into the nature of that fly. It is with much propriety called a Weevil, as it destroys the wheat even in our granaries, though it is not of the kind termed by naturalists the Curculio, of which they have given a very long list; for it is not like a bug, it carries no cases for its wings; neither has it any feelers, with which the Curculio is always distinguished; and perhaps (as I fancy it will turn out in the course of this letter

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that they never attack grain when hard) they really have no occasion for such feelers. For from the make of it, to my judgment it appears an impossibility that it should ever perforate into a hard grain, being furnished with nothing in nature, from the most minute examination by glasses, that could make such a perforation; and seems indeed a fly itself, consisting of nothing sensible to the slightest touch with the finger, nor to the eye, assisted with glasses, leaving only a little dry pale brown glossy dust, on being squeezed.

HAVING observed the wheat from my Northumberland quarters, never affected by it; but constantly sound and perfect, through many years that I have been obliged to keep it for my own use, even in the same granary with Weevil-eaten wheat; I was, and am still, inclined to conclude, the enemy is some how lodged in the grain before it grows hard. It might not have been then too late to have had that better proof of this, which I have since been able to get, by discovering little eggs and maggots half formed into flies in the grain. But as I had nothing particular at first to lead me to such an examination, I waited till the next crop; and at all times, between day and dark in calm weather, during the several days of growth from the blooming time, till the livery or hardening state of the grain, I visited a field, if possible, to discover whether any of these flies appeared amongst the heads of the wheat during the soft state of the grain. Accordingly, in a pleasant evening, after the sun was down, and every thing serenely calm, I found the rascals extremely busy amongst my ears, and really very numerous. I immediately inclosed some of them in a light loose handkerchief; and by the magnifiers of my telescope, I took occasion minutely to examine them.

THEY are a pale brownish moth, with little trunks or bodies, some trifle shorter than their wings; and as some of their little bodies appeared bulging as if loaded, I applied the pressure of a fine straw upon them, and saw them squirt out, one after another, a number of little things which I took to be eggs, some more, some less; some emitted fifteen or twenty of them, and others appeared extremely lank in their little trunks, which

I could not make discharge any thing like an egg. Whether they had done this in the field before, or were of the male kind, I could not tell, but from this discovery I find in my diary, many years ago, this conclusion, "that there need not be above two or three flies to an ear of corn, to lay eggs enough to destroy the greatest crop."

I must observe, at that time, that the bloom or farina of the ears had for some days disappeared, and the grain was nearly filling, though in a kind of milky state; and at such a time the husks or capsules are generally sufficiently open to admit the entrance of such flies; for I imagine, that as nature certainly intends that farina to impregnate the grain, and as that could only be done by its falling into the capsule, she must necessarily favour such a process by opening the mouths of those vessels.

SOME agree with me, that the fly does not perforate the grain, but they say it lays its eggs upon the top of the husk, and when they are hatched into maggots, those eat through the husk into the grain; but I must think such a suggestion certainly liable to many objections, even in the pea, from whence such gentlemen have drawn their arguments: The egg of that bug, they tell us, is laid upon the back of the pod, next the pea; and from thence it hatches, and eats through the pod into the pea. The settling of such a point seems to be of little consequence, but to justify nature or providence in the wisdom as well as perfection of its modes. Can it then be presumed that an insect should, by particular instinct, be directed, to deposite its eggs for its species into a proper nidus, which should be also a pabulum for the young as that egg hatches, and yet that they should only be permitted to do this upon the outside of the coat of the nidus, from whence it may be liable to be removed by numberless accidents? For where one egg only is laid, the viscus matter that might surround it, cannot reasonably be thought a cement sufficient for a grain or husk in actual growth, as it might be with a number of eggs studded together on a leaf, or round a twig, according to the nature of some flies. Again, should even so

small a viscous matter confine the egg to the outside of the pod or husk, against many accidents, yet what can we suppose will preserve the maggot, just hatched, from those accidents, when it lies on the outside, on the back of the pod, or husk? Besides, I must think I have discovered an egg as well as a maggot under the skin of the pea, without any visible lead to it, which must be a conviction it is not a maggot till it is hatched in the pea; therefore it seems reasonable that the parent of that bug perforates the pod, and then into the pea, in its tender and soft state.

I wish then such a suggestion may not have arisen from the callous speck that may be observed, with which nature closes up the wound made in the pod, by the parent of that bug. But how is this business of the worms eating through the husk of the wheat, and then the grain, till they come out in a fly, a little above the germ, at the other end of the grain, to be thus constantly performed, if the egg is only laid upon the end of the husk? For we clearly see those eggs do not all hatch at once; and after the wheat is thrashed out, in which operation, to be sure, it must endure a pretty rough usage (effect that business as you will) how can it run so many chances, without being dislodged or destroyed? I may further ask, what should support the maggot from its hatching, till it gets through the husk into the grain? We see in most other species of insects, the worm, maggot or caterpillar, begins to eat as soon as it can twist about, and certainly the husk cannot be the first pabulum intended by nature for this maggot. Besides, from the observed tenderness of such maggots, if they are not well preserved from scorching sun beams, wind or rain, they must be subjected to various destructions, if the egg can be supposed to be hatched but in the grain; and it could not in any wise be the intention of nature, that they should be destroyed by their own misconduct; for we discover, in other instances, that her tenderness to flies, which propagate by eggs, directs them to deposit their eggs on the under side of leaves, that are a good security against the force of sun beams and weather; and as soon as they hatch, those leaves become the immediate food for those maggots, worms or caterpillars.

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THE same arguments must hold good against the eggs being laid on the end of the grain ; and it is no new thing to advance that hundreds of bushels have been carried very fair to every eye, from the barn or treading floor, into the granary ; where, if thrown into a heap, the collected warmth vivifies the egg, and, in proportion to the growth of the maggot within the grain, the warmth is increased ; and even whilst the middle or lower parts of the heap shall be alive, and ready to fly away, the upper parts shall be quite fair, and yet nevertheless hatch even at some distant day, with a proper warmth, if not perished by any coldness or other excess in weather, or by art : I say then, in such a length of time before hatching, the odds are greatly against the egg or worm's sticking to the grain till it hatches or eats in.

THESE things being considered, I thought that I had advanced far enough in investigating this point, to be convinced the evil was effected by laying the egg in the grain, and in the soft state of it ; and that those observations, said to be made of the egg being laid on the husk, or on the outside of the grain, were inaccurate, and espoused without a due consideration. But, in order to make it as clear to others as myself, I must here beg leave to assert, that I have distinctly seen with my glasses the egg in the grain of wheat, at the upper end of it, beneath the skin, and round it a small yellow stain, as if the milky substance had received a tincture from the egg ; and as a further confirming circumstance that these eggs are laid in the soft state of the grain, I find in my diary, that many years ago I visited a field of one of my neighbours, who having been extremely late in his harvest, in very warm and temperate weather, had his wheat all eaten out ; the flies were crawling out of the ears, and this whilst the wheat was standing.

AGAIN, that the conviction may be as full as possible, it is an indisputable certainty, that this maggot eats from the upper end of the grain, as it stands in its husk, down to the lower end, and comes out in a fly a little above the germ. Now to suppose that these eggs are laid constantly upon that end of the

the grain, is to believe this fly capable of distinguishing such particular end, in every confused direction that the grain may be thrown into after it is thrashed out; and therefore the notion of the fly's laying its egg upon the outside of the grain, and that egg's never being dislodged, and the maggot's hatching upon that end, and eating into the grain, without being removed from that particular end, must be an absurdity of the first magnitude. In the husk indeed the fly might find that certain end of the grain, because in that it always lies in its proper direction, and it is reasonable to conclude that instinct would serve a fly for such a purpose; but then this cannot remove the absurdity before taken notice of, that of laying its egg upon that end of the grain constantly, as well before as after it is thrashed.

NATURE, I may say, from the minuteness of her ways in effecting her intended purposes, is frequently out of the comprehension of man, and although his microscopical improvements upon vision have helped him to many discoveries, numerous are the things that seem still to remain as a secret to him. We can see in some flies their immediate changes from the first process of propagation, quite through their periods of life; and from thence we are inclined to pronounce a rational history of their continuance, brood after brood: Yet in some flies, though we can carry them through all these several changes, there are certain phænomena not to be accounted for; particularly, how the length of time between their changes into flies, and their laying their eggs for the continuance of their species, is employed by them. This defect we generally supply by conjecture, that the time is spent in some torpid state: But there are some discoveries as to certain insects, that make it extremely difficult to suppose such a state; and if we regard what naturalists tell us of some of the moth flies, and indeed our own observations upon them, "that after they become a fly, they never attempt any kind of sustenance, but are seemingly solely employed in the business of fecundation, and the females in particular, in depositing their eggs for a new brood," we shall be puzzled to account how insects, that never eat after their change into a fly, can exist through so long

long a period as a great part of the fall, and generally of a long winter, till the period of the soft state of the new grain; and to what shelter they can retire from such a series of weather, generally too severe for such tender forms. We may imagine some intermediate brood, but what shall we fancy to be the nidus or food to bring them to this fly weevil again, ready for that new period of softness in the succeeding crop of grain? From hence, perhaps, it is that some gentlemen have grown fond of the opinion, of their eating out of one grain, and then flying to another grain, and laying their eggs upon the ends of them, for a new brood; but as even weevil eaten wheat is generally consumed one way or another, long before the kerning of the new crop, the difficulty (by such a supposition) will have many long months to contend with. Therefore others tell us, they lie about in barns, &c. However, the standing crop eaten up, before taken notice of, is with me sufficient to confute such a solution of that difficulty: And I might add my own strong fumigations of my barn and granary (though enough to destroy a world of insects) have been unsuccessful, with respect to this fly weevil, in the new crop.

I must here step aside to inform you, that though my wheat would, when weevil eaten, pretty generally come up in the field, yet when I was obliged to sow it, if I did not double the usual quantity (which the season always governed me in) the ground would be scanty, and extremely beggared for want of seed. I readily concluded the cause of this to be, that the grain was too much eaten (that is) the maggot was too far advanced in it, and therefore such grains perished; and indeed for satisfaction in this point, I twice tried, after washing the grain, and drying the light chaffy stuff that swam at top, to sow those grains, and constantly found all that I could squeeze flat with my fingers, never sprouted, sow them how I would. This, I hope, will be looked upon as a very good answer to both of those hasty assertions, that such wheat will nevertheless grow when sown, and likewise make a tolerable flour; for grind it how you will, I must be bold to say, it can produce no flour at all; and the flour imagined to be got from weevil eaten wheat, is only from such grains of it that have escaped the

the weevil, or are but half eaten, perhaps by the maggot's not having run its course in nature before it was destroyed; which is the presumed cause of that prodigious clamminess in bread, from wheat that has the weevil in it, as the moisture of the maggots continues in the flour; but in biscuits that clamminess may be dried up, by the heat of the oven, as those cakes are generally very thin.

THE author of the Complete Body of Husbandry, vol. IV, page 347, of the octavo edition, speaks of a fly in England, that sometimes attacks the wheat in its soft state; and calls it a small black fly, not bigger than a large pin's head. He says they fasten on the ear in numbers, eat into the corn, and lay their eggs, which hatch into maggots, and devour part, and spoil the rest of the grain. He further says, the fly may be dislodged whilst it crawls on the ear, for they are so tender, that a very little force will destroy them, and that they only appear in dry years, for rains in any quantity destroy them; and from thence recommends the Irish method of rope hauling the wheat in dewy mornings, to brush the fly off, which will then be destroyed.

I CANNOT readily agree with him here; for certainly as the fly got to the ear before, it is reasonable to think it could, after falling off, crawl up again, unless the fall could be supposed to crush so small an animal as a pin head. Therefore I was persuaded, unless the disturbance of rope-hauling was constantly given, the fly would return again so often, as to make it a tedious work of many days, at least every morning and evening, from the casting of the bloom, to the hardening of the grain. I have since fancied, that by the same author's method of fumigating turnips, just come up, in his third vol. page 348, with orpiment, every here and there, thrown about on live coals, to windward of a wheat field, in a gently moving air, the prodigious thick foggy smoak raised by that drug, might kill the moth-fly, as he says it will do the turnip-fly, without injuring the turnips, even in vegetation. I say, I imagined the doing this pretty often in the wheat field might be of service; for though orpiment is of an arsenical nature,
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as I found it so strongly recommended, and have also read, that though poisonous, it had been successfully prescribed to be worn round childrens necks, as a destroyer of worms; I at first thought that might do: Yet as fire often renders things (really safe and innocent when crude) very noxious, there might be a possibility of danger in it; and reading of many bad symptoms occasioned by it to the shot casters, who use it to increase the fluidity of their lead, that it may run quicker or more certainly into globules, I could not think (upon better reasoning) to make use of such an experiment.

My end in all this enquiry, was to prevent the destruction made in wheat, by destroying this insect in its egg; and I imagined I had foundation enough to conduct me to that point, from the accounts given of hatching in Egypt, and what we may collect with certainty from Du Reaumer's elaborate treatise upon raising fowls; besides many little family observations, that corresponded with the common sense of things. Experience shews, that a fowl greased (as they sometimes are under the wings to kill the lice) can never hatch an egg. I also remember a lady, curious in turkeys, in order to produce a forward brood, set her hens in her smoak-house, whilst her meat was hanging, but the eggs did not produce one pout; and it was discovered that the hens had been greased by the accidental drippings of the meat.

As these discoveries squared with the French method of preserving eggs, by tallowing them over, founded certainly upon the principle of keeping out the air, which would otherwise give them, in long voyages, a noxious and disagreeable taste of staleness; I thought I might conclude, that besides warmth, air was essential to the vivifying or hatching an egg; and the hen-house wives confirm me in it, by their constant observation, that hens, &c. not only turn their eggs, but leave their nests, at proper periods; and those that hatch well, cool themselves frequently with water, whilst others perpetually brooding (if they do not die themselves) addle their eggs.

Upon these two principles then of heat and air, I thought myself pretty certain of effecting the destruction of these eggs

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in the grain; and therefore I endeavoured to hit upon such a method for their destruction, which should be attended with the least labour and expence. Too much warmth, or too little, or an entire exclusion of the air, must do the business.---

Could it be consistent with the prudence of a farmer to thrash out his grain as soon as reaped, to be sure a drying kiln might be so constructed as to destroy these eggs, by communicating too much warmth; but as there are many reasons for a farmer (besides his other necessary business) not to thrash out his grain so soon, lest he introduce the other inconveniency to his crop of mustiness and bad scent, I was obliged to bend my thoughts wholly to the exclusion of the air; for wheat, I know, will contract a degree of warmth in the mow, which is oftentimes of great service to plump out the grain, by something like an after circulation in the straw; and to increase that degree of warmth, so as to destroy the eggs of the Weevil, might be a means to mould the straw, and funk the grain; therefore I say, I fell solely upon the exclusion of the air as much as possible; and this I was happy enough in effecting with great success to my crop for many years, till my old age and infirmity prevented my attending my servants whilst they were pursuing my directions; and not till then had I the least reason to complain, whilst others were eaten up in their crops; but villainy and negligence are such concomitants in servitude, that I have been again destroyed, plainly to be accounted for from the visible abuse of my constant directions. The method I have taken is this.

I REAP as early as I possibly can, respecting the dryness of the grain, as well as the straw, which would otherwise funk it. At least two feet quite round the mow I leave a vacancy, which is to be well trod with soft hay, or beaten straw; therefore I keep persons constantly treading down those margins as the mow rises; and when I reach the eves of my barn, I lay on and tread down a very thick covering of the same straw or hay, and weighd it well down at top. Had I not found this effectual, I would have gone to the expence of filling in and plaistering my barn, being convinced that the exclusion of air, as much as possible, could be the only effectual method of killing those eggs, which as they are so very small before hatching,

hatching, could not give the least disagreeableness in either look, taste or quality, in the flour. This method I published many years ago; and many gentlemen have assured me, they have practised it ever since, and continue to do so now with the greatest success. The farmer that chuses to try it, if he suffers nothing to prevent an early harvest, will, I am persuaded, confess the justice of what I have suggested; but if, by any means, he should be late in his harvest, and the temperature of the weather should be suited to the principles of hatching; or if he should be too early in beating out his grain, it cannot then be of any real service, but by accident, as the mischief may be done in the field, and an egg not destroyed in the mow, may hatch in the granary.

You must here permit me to tell you, I have constantly laughed at all those ridiculous nostrums of brining, &c. to prevent this injury of the weevil, as well as that other destructive evil called the rust. They may be of service to quicken the vegetation of the grain; and it is reasonable to conclude they will destroy all vermin that lie in the ground when it is sown; but that this brine, or any other solution, can remain and pass through the course of circulation, in a very long series of winter months, and preserve its virtue to the kerning time of the grain, so as to prevent these flies from invading it, or indeed to check or correct the corrosive moisture of particular airs, which produce rust, is an absurdity below the dignity of a rational man; notwithstanding many writers have given into it. I always looked upon those gentlemen, as forgetful of the philosophy upon which they set out within the first parts of their works; and I suppose to make a book of bulk, they stuff in the errors of old and obstinate farmers, from one century almost to another. I remember I had an ass of that kind, and for the sake of conviction, I indulged his project of steeping and brining; and went so far as to leave him a parcel of wheat which he might put up or mow as he pleased; and though his obstinacy would not suffer him to be convinced, I was, to my cost, whilst the rest of my grain, conducted by my direction, was good and useful. Quicksilver, we are lately told, will circulate with the juices of a plant in vegetation, without injury to it, and it has been successfully

applied that way to kill the slugs and snails on wall fruit; yet if the difficulty of inserting it, or impregnating wheat with it, before sowing, could be got over, I cannot suffer myself to embrace any persuasion, that the virtue or subtilty of the quicksilver could continue so many months in the wheat, by any kind of innate quality, in such a long stage of growth, through a very bad winter. Therefore even that discovery, in my opinion, has not removed the absurdity hinted at. I have mentioned the rust, as presumptively occasioned by some corrosive quality in the air; and though it is out of my present subject, I will just hint that Du Pratz, in his history of Louisiana, takes notice of such a destructive obstruction to the raising of wheat in that country, though he does not call it by any name that conveys an idea of rust. He speaks of it as a brown red pearly drop, found at the lower joint of the stalk, which, in a short time, pervades the whole stalk upwards, and perishes the grain: As this is pretty similar to what we discover here, it may not be amiss to look upon it as a corrosive substance, communicated by the air; and I do believe it will be found to be the better opinion, upon a more accurate investigation; for I have long been satisfied, that the ascension of the juices are thereby prevented; and the rusty dust seems to be nothing more than those juices oozing out of those corroded parts, or wounded pores, that turn to that colour on drying; however I must declare, I never yet discovered Du Pratz's brown red drop on any wheat of mine, notwithstanding it has sometimes been destroyed with the rust. This rubigo was a disorder observed in wheat of very ancient date, and the writers, from one to the other, recommend preventing it by brining, &c. as before; some indeed just hint at the truth, by calling it by the general term a blight; but why they should think of curing blights by an application before sowing, is a curious mystery, it should seem as if such men fancied, that the possible constitutions of air can as easily be prevented by their brine, as it can be kept out, or exhausted by an air pump. Some, indeed, impute both weevil and rust to certain soils; but as wiser men than I, have seen cause to complain of the absurdities that have been adopted by writers that were good philosophers in other matters, I shall not give myself any trouble to endeavour at an explosion of such an opinion, well knowing

Knowing that all lands, where air and moth can come, may be, and are subject to those evils, when they are about; and indeed every sort of wheat that I have tried, has been attacked by them both; but from barley and rye's constantly escaping the weevil, I am at present persuaded their protection happens only from their beards or awns; therefore a long bearded wheat would be worth propagating for a trial, as I never heard the bread made from such ever objected to, nor indeed its increase complained of. This I say, believing that those gentlemen who tell us that bearded wheat has been destroyed by the fly weevil, are some how mistaken, from the improbability of the fly's getting into the capsules through those awns. They give for a reason, that the awn in wheat never sticks to the grain, as it does in barley; but as I never saw rye the least affected by the fly, which is of a similar growth with a grain of wheat, and has no awn growing to it, though the husk has; I must conclude it may be still some mistake in the asserter; for certainly those awns, even on the husk, if any thing long, must embarrass the fly, and prevent his mischievous purpose.

HAVING thus, my good friend, endeavoured to comply with your request, it remains that I should make some apology for the length of it; but if we consider enquiries into nature must be more or less prolix, according to the helps that can be got, you possibly will think any endeavour to be shorter, might have left my own conclusion less clear and intelligible. I know not how convincing my arguments may be, but you have my free leave to make use of them as you please; and I shall be glad, through your means, to read any thing that may shew wherein I am mistaken.

I am, dear Sir,

Your very respectful humble servant,

LANDON CARTER.

Sabine-Hall,
July 23, 1768.

Same Subject, by the COMMITTEE of HUSBANDRY.

AN enquiry into the means whereby the injury of wheat in America from flies, may be lessened or prevented, is attended with difficulties and uncertainty here; because the members of the committee are at a distance from the immediate seats of observation, and cannot obtain that accurate knowledge of facts, which is requisite to insure the principles they adopt from errors. However, this is not thought a sufficient objection to their doing all in their power towards putting so interesting a research on a plan of investigation, and furnishing gentlemen, of learning and leisure, in the places where the mischief prevails, with hints that may serve as a basis to such a series of observations and experiments, as may probably be productive of the desired discovery.

It is said the injury of wheat from flies began in North-Carolina, about 40 years past, where it has been difficult to preserve it ever since, unless in spring-houses, or other cool places; and that the Indian corn of that country being of a soft and tender quality, is also liable to be injured by the same insects, but may be preserved from them, by keeping the cob covered with the under leaves of the husk.

THAT these mischievous flies have extended gradually from Carolina into Virginia, Maryland, and the Lower Counties, on Delaware; to the last of which places they did not arrive till seven years ago, and had not yet penetrated into Pennsylvania, or passed the Delaware. That in the transit they have been principally confined to low level moist lands; and when they have been found in high dry lands, they have been but few in number, and did not remain longer than one season. From whence we may rationally infer, that the high dry lands do not afford them equal conveniencies for subsistence and propagation, that the low level moist lands do, where many things conspire to make all grain raised in them, of a soft spongy quality, and peculiarly adapted to become the food and
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nefts of tender insects; and therefore those are the places in which such insects will abound, and the wheat raised in them, is the only kind which they can pierce and injure. The truth or falshood of this inference may readily be ascertained, by experiments with different kinds of grain, put into a fly-infected granary. The following pertinent experiment is said to have been often tried. Put three parcels of Indian corn into a place with fly-bitten wheat; let one parcel be of the first kind on the cob, and covered with the husk; a second of the hard flinty grains; and the third of the soft tender grains, both the latter shelled; the first and second will be injured, whilst the third is worm eaten in the same manner as wheat.

THE accounts we have of these flies are various; but the most probable is, that they are whitish butterflies or moths, which rest in the day, and are active in the night. They appear to be of the same kind with those that do the like mischief in Europe, which a gentleman of Angumois describes to Mr. Duhamel in the following manner.

“THE great loss, says he, we have suffered in our corn, and especially in our wheat, for 17 or 18 years past, has put us on making strict enquiry into the causes of a corruption with which our grain is infected. The common opinion is, that when the corn is in the bloom, that is to say, in the month of June, small white butterflies lay their eggs in the flowers. When the grain is ripe, the eggs are inclosed in it, and as soon as the corn is laid up to be kept, it is found to ferment. This fermentation raises an heat, which hatches the eggs, whence little worms proceed, which are transformed into chrysalides, and these are afterwards metamorphosed into grey butterflies or moths.”

THIS process of the flies in Europe, conforms with the observations of many gentlemen in America, some of whom assert they have seen the perforations in the milky grains in the field, and in the dry grains of wheat, into which the flies had put their eggs. This is the less to be questioned, since it is the well known manner by which plumbs, cherries and fruit trees, are injured by other insects.

It is said the most considerable injury done to the wheat by flies in America, is after it is reaped and laid up, which the gentleman in Angumois does not mention to happen in Europe. For a few days after the chrysalides are metamorphosed into flies, these flies copulate, and impregnate more sound grains of wheat with their eggs, which again produce worms, chrysalides, and new parent flies; whereby the number of worms is successively multiplied, and the mischief increased during the warm weather, but ceases in cold, and returns again in the spring. The spring flies are supposed to proceed from worms, hatched at that time in eggs, preserved in the grain through the winter; because they are preceded by worms, are short lived, and never seen till the season is become warm; and because very cold winters have been observed to lessen the number of flies the ensuing summer, which is supposed to be from the eggs being frozen, and destroyed in the grain. The gardeners in Europe preserve their fruit trees, and fruit, by carefully destroying the nests of those insects which injure them, and when the eggs of insects are deposited in any known place, or thing, it certainly would not be impracticable to prevent any mischief arising from them. Therefore in this enquiry it may be useful to know, how and where the wheat fly is preserved; if in the wheat, it may be discovered by the following experiments. Expose to severe frost a quantity of wheat, that had been fly injured in the fall; afterwards put this wheat, and an equal quantity of the same parcel, that had not been frosted, into different vessels, and keep them a due time in the degree of warmth requisite to hatch the eggs. If the facts are as above supposed, living worms will be found in the latter, but not in the former.

THE eggs of these flies have sometimes hatched, when the seasons have been extreme hot and moist, in the corn standing in the field. But this rarely happens till after it is stacked or housed, and a fermentation ensues.

THE common method of preserving wheat from harvest till it is threshed, especially in places most subject to the flies, is in stacks in the field. These stacks afford a remarkable phenomenon;

menon; for the south side of them, which is more immediately exposed to the rays of the sun, become soon heated, and hatch the eggs contained in the grains of wheat from the surface to about eighteen inches in depth, whilst no worms or flies are found deeper, or on the north side. If the degree of heat which hatches the eggs in the south side of the stack, and the degree in the north side, which preserves them without hatching, were ascertained by a thermometer, it would lead us to a means of preserving the grain, either by keeping it cool, and thereby preventing the hatching of the eggs, or heating it, so as to corrupt them, without injuring the corn; for the difference of warmth in which eggs may be preserved, hatched, or corrupted, is but small; "93 degrees of heat in 21 days gives growth to the chick in an hen's egg, from a little speck into a perfect animal body; but the same egg would be rendered unfit for producing a chick by a greater degree of heat, scarcely enduring 100 degrees without prejudice, and a much less degree than 93, would not suffice for hatching it." The degrees requisite to hatch the eggs of these flies, to prevent their hatching, or to corrupt them, might readily be known, by putting the same kind of fly-injured wheat in different open vessels, and keeping them in different degrees of warmth, making 93, or the warmth of the prolific part of a stock, the medium standard.

ANOTHER experiment, of great importance in this enquiry, should be made at the same time, to discover whether the eggs of these flies can be hatched, or the worms exist, without the frequent accession of fresh air: This may be made, by trying a bladder close over a vessel, containing the above kind of wheat, and keeping it in the degree of warmth that will hatch the eggs; and if the eggs in the open vessel hatch, whilst those in the covered one do not (which, philosophy teaches us, will probably be the case) it proves that securing the sheaves of corn from the access of fresh air, by covering them close in stacks or barns, with hay or straw, &c. and keeping the threshed grain in tight casks or granaries, will be an effectual preservative of the wheat from the injury of flies. It likewise proves, what is very useful to be known, that fly-injured

wheat in the holds of large vessels, or in deep bulk in granaries, will not receive further damage from insects, but on those surfaces which are exposed to the accession of fresh air.

THE following experiment on pease, is an encouragement to attempt the preservation of wheat, by excluding air from it. Take any quantity of English pease intended for seed, divide them into two parts, put one in an open vessel, keep the other in a vessel well corked; that parcel to which the air has had admission, will be worm-eaten in the spring, whilst the other remains sound, and untouched by insects.

It would be a great point gained, to destroy all these flies in granaries and mills, by poison vapour, if it could be easily done. But Mr. Duhamel says, no other vapour, but that from burning sulphur, which is injurious to the grain, will do it. This assertion is extraordinary, and the truth of it is to be doubted, since all other insects are readily killed by vapours of various kinds. "If bones of animals, or hartshorn, are laid on an open fire, in a room where the smoke is confined, it will kill all the bugs, fleas and flies in that room: But the least nauseous, and yet the most deadly vapours, are from the suffocation of fire; thus the spirits of charcoal, confined in a close room, kills the strongest animals in a short time;" and therefore it may rationally be expected, that a pot of these coals fired, in a close granary, could not fail of destroying the flies in it in one night: However, there is no determining this matter *a priori*, because of the difference in respiration between animals and insects; the former taking in air by the nostrils, and the latter by a perforation in the abdomen. But if the fumes of burning charcoal be inoffensive to the flies, it is probable that filling the room with a thick, pungent, oleaginous smoke, such as arises from burning the stems of tobacco, would soon destroy them, by clogging the air passages in the same manner as oil, which applied to the sides of insects, kills them immediately. Both these experiments may be easily tried, and if they fail, others suggested.

WHEAT.

WHEAT being now in bloom, and the flies probably very busy in impregnating the tender grains with their eggs, all that can be done this season is, to prevent the hatching of those eggs, by threshing out the corn as soon as possible, and drying it in kilns or the hot sun, and keeping it afterwards in tight vessels, or deep bulk in close granaries: If it should heat in the vessels, it might be readily cooled, and kept so, by ventilating it an hour once a week, with a pair of common house bellows, according to Dr. Hale's direction.

It should not be stirred in bulk, if it can be avoided, that it may quickly encrust upon the top, and exclude the air.

If it is not convenient to thresh it out early, the sheaves should be defended from the accession of air, as before proposed, till late in winter, and afterwards kept in bulk, or tight vessels, to attempt the prevention of spring flies; for which purpose the wheat should be threshed out before spring.

If the stacks of wheat have not been preserved from the injury of the flies, the injured part should be threshed separately, and the wheat used immediately, or destroyed, or the eggs in it prevented from hatching: When flies appear in granaries, they should be killed immediately, to prevent their doing further mischief.

BUT as all these things require additional labour and expence, it is much to be wished the injury could be totally prevented; and which, it is reasonable to expect, may be attained solely by a proper change of seed-grain annually; that is, to sow the low moist lands with hard, dry, flinty wheat, of high mountainous lands, instead of their own product. For it is well known to naturalists, that the quality of fruit, grain and vegetables, depends on the climate and soil: The apples of a Newtown pippin-tree, growing in New-York and Virginia, have scarcely a resemblance in taste. The vine from which Burgundy wine is made in Burgundy, when transplanted into Champagne, produces Champagne wine; and the Champagne vine, transplanted into Burgundy, makes Burgundy wine.

Beans and pease from England, planted in America, soon dwindle much from the originals; and the alteration that soils and climates produce on wheat is so well known, that all careful farmers in Europe change their seed-grain often; this is so remarkable in America, it is observed, that the red flinty wheat which grows in the strong mountainous lands, when sowed in low moist places, undergoes a gradual change for four years, and then becomes light coloured, thin skinned, and of a soft texture; and that this wheat sowed in the high lands, takes the same time to recover its natural colour and quality. Therefore if the injury of wheat from flies depends on the soft quality it contracts by its growth in moist low lands, a proper annual change of seed-grain, will alone prove an easy and certain remedy against the present destructive and alarming evil amongst us.

Observations on the native SILK WORMS of North-America,
by Mr. MOSES BARTRAM.

Read before the Society, March 11, 1768.

I H A D, for a long time, a desire to know, if some of the wild silk worms of North-America could, with proper care, be propagated to advantage; accordingly, in March, 1766, I made an excursion along the banks of Schuylkill, in search of some pods or cocoons, in which the worms spin themselves up and lie concealed all the winter, in the nymph state, preparing for a change in the spring, namely, from an aurelia to a fly.

I was so lucky as to find five cocoons that had live found nymphæ in them. These five I placed in my garret opposite to a window, that fronted the sun rising. I did this, that the warmth of the sun might forward their coming out.

May 10. ONE of the flies came out; but the window happening to be left open it made its escape.

May

May 13. ONE of my pods produced a large brown fly, beautifully spotted, next day two more of them produced each a fly.

May 17. ONE of the flies, which came out of a large loose pod, began to lay eggs. On the 22d, the other two, which were males, grew very weak and feeble and unable to fly. Next day one of them died, and the day following the other died; the female fly all this time continuing to lay eggs; on the 24th at night she also died, having laid near three hundred eggs. *May 31,* my last pod produced a large female fly, of the brown kind like the rest. But there being no male I could expect no increase from it. *June 3d,* she began to lay eggs and continued some days: On the 8th she died, having laid upwards of two hundred eggs. These which my last fly laid looked at first large and full, but in a few days they began to shrivel and be indented in the middle, as did all the rest. However, I folded them all up in separate papers and laid them by, to see if any would hatch the spring following.

THE male fly is less than the female, but his colours are brighter and more beautiful.

IN the spring of the year 1767, I examined the eggs, and found them all dry, and not likely to produce worms; from whence I concluded they had not been impregnated by the males. This was a disappointment to me. But being still of opinion, that they might be propagated, I determined to make another trial with more caution and circumspection. Accordingly, I set out in search of cocoons, and gathered several of them both from the swamps and upland. Those from the swamps I got chiefly off the alder; those from the upland, off the wild crab-tree, and the viburnum or black haw bushes.

THESE pods I placed as I had the others, before my garret window, where the sun might shine on them, as soon as it arose, and a great part of the forenoon. When I expected the flies were near coming out, I tacked coarse cloths up against the windows on the inside, not only to darken the room, but also

also for the flies to settle on, and to prevent them, in attempting to make their escape, from beating their legs and wings to pieces against the glass, which I found to be the case last year, and which it is probable, prevented their copulating.

May 16. THREE of my cocoons produced each a fine large fly of the brown kind, the same as those of last year. The two following days two more flies made their appearance, and one of the eldest began to lay eggs, which not being impregnated, dried up and yielded no increase.

May 19. ONE of the males that came out on the 16th, copulated with the female that was produced on the 18th. They continued together about twenty-four hours; a common case with most of the insect tribe, which lay a great number of eggs at once. And something similar may be observed in some other animals.

May 22. THIS female fly began to lay eggs which looked plump and fine. Though I had now several flies, yet this was the only one from which I had any increase.

June 2. THE last of my flies died, all expiring regularly as they came out. The period of their existence is short, seldom exceeding nine or ten days, though some of the females lived to the age of fourteen or fifteen, as I found by one I had last year.

June 3. THE eggs that were impregnated began to hatch and produce worms, to which I presented for food the leaves of our common mulberry; but they did not seem fond of them. I laid before them several other kinds of vegetables, and observed that they seemed best pleased with the alder.

June 4th, 5th, and 6th. THE eggs continued hatching and producing young worms.

June 8. THOSE first hatched left off feeding, shrunk up short, and seemed motionless. I imagined they were sick and changed their food, trying almost every kind of vegetable,
in

in hopes of finding something that would agree with them better; but all to no purpose. Having killed several in shifting them from one kind of food to another, while the rest still continued in the same torpid state, notwithstanding all I could do, I thought all my hopes of raising them were frustrated and concluded they would perish.

June 9. I WAS agreeably surprized to see the little animals, that I had given over as dead, creeping out of their old skins, and appearing much larger and more beautiful than before. Finding themselves disengaged, in a little time, they turned about and fell to devouring their old coat, which seemed a delicious repast to them; after which they rested about twelve hours, and then began to feed on leaves as formerly with great eagerness.

June 15. THE eldest worms again left off feeding, shrunk up very short, and appeared fixed on the leaves almost motionless. In this situation they continued until the 17th, on which day, after appearing to be very violently convulsed for near half an hour, they threw off another skin, which they eat as before, and then resting about twelve hours, fell to their usual food.

June 20. ONE of my worms, that had just disengaged itself from its old covering, whilst it yet remained weak, was destroyed by a kind of bug armed with a long bill, with which it pierced the side of the worm, and sucked out its vitals. This bug, which I fancy, I must have brought in with the leaves, I take to be a common enemy to the silk worm in its tender state. Its bill is so long, that it can stand at some distance from the worm, and with its weapon wound it, notwithstanding the bunches of hair or bristles, in form of a pencil, with which the worm is covered, and which are its principal defence.

June 23. MY oldest worms left off feeding, shrunk up, and on the 25th, threw off their third covering, which they devoured, and, after resting the usual time, returned to feed as before.

July

July 2. THEY left off feeding the fourth time, and on the 5th parted with their fourth covering, after eating which, and resting as usual, they continued to feed on the leaves.

It is remarkable every change they undergo adds fresh beauty to the worms, and in every new dress, they appear with more gaudy colours and lively streaks.

July 22. Two of my oldest worms left off feeding and began to wander about in search of a proper place to spin. Thereupon I got sticks, in which I fixed a number of pegs for the greater conveniency of the worms; though they can spin in any place, where they have or can form an angle for their webs. After wandering about some time, they fixed at last and began to spin in a curious manner.

July 23. Two left off feeding; these I placed on the racks I had made, which I fixed in glass bottles to prevent the worms from getting off: For I found they were apt to ramble greatly before they could fix on a place to their liking, if they were not suffered to spin among the leaves they feed on; in which case they begin to spin soon after they leave off feeding. But I did not like to suffer this, as they seemed fond of drawing bits of twigs and leaves into their nests, which must obstruct the unwinding the silk. One of them spun on the rack, the other got to the window and spun in the angle of that.

July 24. FIVE left off feeding; and having wandered about all night began, early next morning, to spin. In like manner the rest of my worms, as fast as they arrived at a state of maturity, daily applied themselves to spinning or wrapping themselves up in cocoons. *August 10.* The last worm left off feeding, and like the rest wrapped itself up, in which state I expect they will all remain, until *May* next, when each of them, I hope, will produce a beautiful fly.

It seems strange there should be an interval of no less than nineteen days between the time the first and last worm began to spin, though they were all hatched within three or four days
of

of one another, which was nearly the space of time the parent fly was laying the egg. Whether this was owing to the weakness or strength of the vital principle in some more than in others, or whether to the shifting their food, or to their being frightened, and thereby prevented from feeding, I cannot tell. Farther experiments may possibly explain the matter.

THE method I took to raise these worms, with the least trouble to myself, as I live in town, and consequently had to bring food for them out of the country, was as follows: I filled several bottles with water; in these bottles I placed branches of such vegetables as the worms feed on. I placed the bottles so near each other, that when any of their food withered, the worms might crawl to what was fresh. By this means I kept their food fresh for near a week. I always kept the bottles full of water, whereby the worms were supplied with drink, which seems necessary for them. Without it they will not feed kindly. They commonly crawled down two or three times a day, drank heartily, and then returned to feeding. The leaves of the apple tree seemed as agreeable to the worms as any I tried; and they answered best, as they kept fresh in the water longer than any other.

FROM fundry experiments, I found the worms averse to changing their food. On whatever they first begin to feed, they keep to it.

If any should incline to propagate these worms, I would propose the following method. Let long narrow troughs be made, with a number of notches along the edges. In the bottom of the troughs, on the outside, let pieces of straight wood be fixed, so that the branches, on which the worms are to feed, may lie in the notches, and their ends be fixed under the piece of wood at the bottom. This would keep them steady, and lying thus inclined, they would more freely imbibe the water for the refreshment of the leaves. The dung of the worms would fall clear of the troughs, and the water thereby be clean for their drink. The troughs should be always kept full of water, and placed in a shade, secure from the violence of wind, which might shake down the worms;

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but not too much confined, because a little air is agreeable to them. Through a hole in the bottom of the trough, the water might be let out every two or three days, and the troughs filled again with fresh water, which by this means would continue sweet and clean.

By this method, I am persuaded, they might be raised to advantage, and perhaps, in time, become no contemptible branch of commerce. They appear to me much easier raised than the *Italian* or foreign silk worms. I did not lose one by sickness. They hatch so late in the spring that they are not subject to be hurt by the frost. Neither lightnings nor thunder disturb them, as they are said to do foreign worms. And as they lie so long in their chrysalis state, the cocoons may be unwinded at leisure hours in the ensuing winter. One thing more in their favour is, that one of their cocoons will weigh more than four of the foreign worms; and, of consequence, it may be presumed, will yield a proportionable greater quantity of silk. These properties, not to mention their being natives, and therefore accustomed to our climate, and the variety of vegetables, on which they feed, must render them much more promising than the eastern or foreign worms, and, it is to be hoped, will induce some who have leisure to make further trials of them. Any time before the middle of *May* will do to collect them. Now is the time to collect the cocoons, and with a little pains a sufficient number of them may be found in almost any swamp or level piece of land, to make a beginning.

I would advise them to prepare boxes, in the following manner: They may be of any convenient length, about six inches deep, and four or five wide; without a bottom, and instead of a close cover for the top, let there be strips of wood nailed on, so close to each other as not to admit the worms crawling through. Let there, also, be several holes in one, or both sides, big enough for the worms to be put in at, as they want to spin, and then stopped up. The inside should be washed with a solution of gum Arabic, or cherry tree gum. The boxes may stand on any flat place to prevent the worms getting out; and when the silk is to be unwound, by immersing the boxes in warm water, the cocoons may be taken out without breaking the threads of silk.

A Memoir on the DISTILLATION of PERSIMONS,
By Mr. ISAAC BARTRAM.

THIS Society having proposed at one of their meetings in November last, that a trial should be made for drawing a spirit from the fermented juice of the *Persimon*, I was appointed to make the experiment.

THE season being then so far advanced, I apprehended it was too late ; but being still urged by the Society to make the essay, I purchased about half a bushel of the *fruit* in the month of December, which was so much damaged by the frost and rain, that I almost despaired of success ; the proper time for gathering it being in the month of October.

I HOWEVER proceeded in the following manner.

I CAUSED the *Persimons* to be well mashed, and put them in a five gallon keg, to which I added two gallons of water, and about two penny worth of *yeast*, in order to promote a fermentation. This being compleated, I committed the whole to the *still*, and drew there from near half a gallon of proof *spirit*, of an agreeable flavor.

FROM the success of this experiment, I think it may be concluded, that the *Persimon* may be rendered very beneficial to those who have many of them growing on their plantations, and that they are worthy of the public attention, as many advantages may be reaped from the cultivation of the trees ; some of which I shall hint at in the course of this paper.

To those who would undertake to collect large quantities of this *fruit* for distillation, I would recommend the following process.

LET a number of empty hogheads, in proportion to the quantity of fruit, be provided ; take out one of the heads of each, and in the other let a hole be bored, at about four inches

from the chimb, into which fix a plug, which may be occasionally taken out from the lower end, when the casks are fixed upon trussels, at a small distance from the ground. In these casks, over the holes, lay a number of small sticks, covered with straw, about two or three inches thick, to prevent the pulp from choaking them.

Your hogheads being thus prepared, fill one of them half full with *Persimons*, which have been well mashed; add water until it arise within one third of the top; then cover the cask with the head that had been taken out, and let it stand about nine days; by this time the pulpy or feculent part of the fruit will be separated by the act of fermentation; you are then to draw off the liquor, by the hole in the bottom of the hoghead, and put it in a tight cask, closely bunged up, to prevent a second fermentation, whereby your liquor would become acid, and be rendered unfit for the *still*.

HAVING thus extracted the more vinous parts from the first hoghead, let as much water be added as before, which must be well stirred, and mixed with the pulp, thereby to procure the whole strength of the *fruit*.

A SECOND hoghead is then to be charged half full of *fruit*, well mashed as the first, and instead of pure water, fill it two thirds full with the second extract of the first hoghead, leaving it to ferment, as before directed. This fermentation being perfected, draw off the liquor, and let it be bunged up close. The third hoghead is to be treated as the second, and in like manner every succeeding cask. After you have in this manner converted all your *fruit* into a fermented liquor, let it be kept at least one month before it is distilled, if it can be preserved without danger of its becoming sour; for I have observed that vinous spirits, drawn from, new fermented liquors, are not equal in flavor to those which have been meliorated by age.

THE *Persimon Tree* is of a quick growth, and yields great quantities of fruit in a few years after it is planted. The wood

wood is hard, has a fine close grain, and may be applied to many mechanical purposes; it burns well, and its ashes contain a very large proportion of salts.

THESE trees grow spontaneously near all our tide water rivers, and succeed in almost any kind of soil. They thrive best when planted in an open place. I would therefore recommend, that they should be fixed at about ten feet apart, round the fields, by which means they would be no incumbrance, but contribute to the support of the fences, as they would serve for live posts. The leaves soon rot, and become good manure, insomuch that it is remarkable that grass grows better under these trees, than any other.

EVERY farmer who has *fifty acres* of land, might plant *three hundred* trees round his fields; which being disposed as before directed, would be a great addition to the beauty of his farm.

LET us suppose each full grown tree will produce *two bushels* of fruit upon an average (some I have seen bear thrice that quantity.) From a farm then of *fifty acres*, *six hundred* bushels of fruit might be gathered; and as from the foregoing experiment a bushel is found to yield a gallon of wholesome and very agreeable spirit, every farmer having that number of trees, might make *six hundred* gallons of liquor as good as rum.

THE expences attending the process, we will suppose to amount to one half of the value of the liquor when distilled, which admitting to be worth but *Two Shillings* per gallon, will leave a profit of *Thirty Pounds* per annum; a sum equal to the interest of a farm that would cost *Five Hundred Pounds*.

WERE we to extend this calculation to what every *fifty* acres of cultivated land in this province *only* would produce, we should find that we might soon become independent of the West-Indies, for the expensive article of rum, and thereby yearly save many *Thousand Pounds* to this colony.

A VALUABLE *gum* exudes from this tree; for the collecting of which, the Society established in London for promoting Arts and Manufactures, offered a premium of *Twenty Pounds Sterl.* for the greatest quantity, not less than *fifty pounds weight*, that should be collected from the *Perfimon Tree*, in any of the British colonies in America, and imported from thence into the port of London, between the first of April, 1762, and the first of April, 1763. And for the next greatest quantity, not less than *twenty-five pounds weight*, a premium of *Ten Pounds Sterling*,

I HAVE also been informed, that an excellent *beer* is made of *Perfimon*s in some of the southern provinces.

HENCE it will appear, that the cultivation of the *Perfimon Tree* is an object worthy the attention of our farmers, as it promises great profit to themselves, and a still greater advantage to the community in general.

A letter from Doctor OTTO to Doctor BOND, gives the following account of an Oil, made from the seeds of the common large SUN-FLOWER, viz.

“ THE oil is made much in the same manner as the
 “ linseed oil with fire, only that the husk is taken off
 “ before it is pounded and pressed; tho’ I think it would be
 “ much better if it had been drawn cold. One bushel of the
 “ seed, in the manner this was made, yields about three
 “ quarts of oil: What quantity of oil one acre of land will
 “ produce, I cannot assert at present; however, there is a
 “ spot of land planted, and the seed now ripening, the con-
 “ tents whereof we will measure, and also the produce, and I
 “ will inform you of the result. It is frequently used by our
 “ brethren, instead of sweet oil, for sallad, and, with a small
 “ addition of the sweet oil, serves very well for that purpose.”

UPON examining some of the oil which was sent by Dr. OTTO, it was found thin, clear, and agreeable to the taste,
 And

And the committee are of opinion, that this oil will supply the place of olive oil for the above, and many other purposes, and may therefore be looked upon as a valuable discovery to America.

Doctor Bond, at the same time, produced a sample of oil, made from the cotton seeds, and sent by the same gentleman, of which he gives this account: This is the ol. bombac. or oil of cotton seed, made in the same manner as the above, one bushel and a half of which yield nine pints of oil, and I have been informed it is successfully used in the West-Indies for the cholic.

An Essay on the expressing of OIL, from SUN-FLOWER SEED, &c. By Dr. J. MORGAN.

*Made in
Sultan's Garden
intercept.
2. p. 77.*

THE grinding of the sun-flower seeds, and expressing of oil from the same, is a manufacture, which, as far as can be yet learned, was first begun among the Moravian brethren at Bethlehem, and reflects honour upon them, whilst it affords the public a new substance, very beneficial in a variety of purposes, but more especially, as it may serve for a salad oil, and for other uses of diet and medicine, in the place of olive oil.

From experiments already made at Bethlehem, it is found that a bushel of the sun-flower seed will yield, on expression, near a gallon of mild oil. The gentleman, who is appointed by the community there to superintend their mills, designs, as we are informed, to pursue a further course of experiments on this subject, the result of which, we hope, will be communicated to this Society.

Our correspondent at Lancaster informs the Society, that some persons in the neighbourhood of that place, have also expressed a quantity of oil from the seeds of the sun-flower. His account is as follows.

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“THE person, who has raised the greatest quantity of the sun-flowers with us, informs me, that one hundred plants, set about three feet distance from each other, in the same manner Indian corn is commonly planted, will produce one bushel of seed, without any other trouble, than that of putting the seed into the ground, from which he thinks one gallon of oil may be made. I observed the land, on which he planted the sun-flowers, to be of the middling sort, and that he took no pains to hill them, or even to loosen the ground about them, which from my own observation on some planted in a neighbour's garden, I take to be of considerable use.

“As the sun-flower is a plant of great increase, and requires much nourishment, hilling does not seem so good a method as that of setting the seed or plant in a hole, and when the plant is about a yard high, to throw in the mould round the stalk, so that the surface of the ground may be even about it. By an estimate made it appears, that one acre of land will yield to the planter between forty and fifty bushels of seed, which will produce as many gallons of oil. The process for making or extracting the oil, is the same as that of making linseed oil, which I make no doubt the Society is acquainted with, and therefore shall not trouble you with it.”

THE success attending the trials already made, give the greatest encouragement to prosecute this useful discovery. And as the seeds of the sun-flower are at this time nearly ripe, and in a proper state for extracting the oil from them, it may be of service to lay these facts before the public. Such as may have an inclination to make trials on this subject, and are not at present furnished with a sufficient quantity of seed for pressing out an oil, may now supply themselves with enough to plant for making experiments the ensuing year.

FOR the information of those, who have both opportunity and inclination to extend the enquiry, and render this a valuable branch of business, but are not acquainted with the general

ral principles, upon which oil is obtained by expression from vegetable substances, it may be proper to observe, that the kernels of fruits, such as walnuts, hickory nuts, filberts, almonds, peaches, &c. and the seeds of many plants, as mustard, rape, poppy, flax, sun-flower, &c. contain a large portion of mild oil. In order to obtain the oil, the kernels, or seeds are commonly rubbed to powder, or ground in mills. They are then put into a strong bag, made of canvas, or woollen cloth, and committed to a press between iron plates, by which the oil is squeezed out, and is received or conducted into a proper vessel to collect it. The plates of the press are often heated, either in boiling water, or before the fire. Many heat the mash itself in a large iron pot, stirring it about with a stick or piece of wood, to prevent its burning, which, when it happens, greatly injures the oil, and gives it a burnt smell and taste, or disposes it to become rancid in a short time. When the oil is drawn without the assistance of heat, it is known by the name of cold drawn oil, and is more valuable, than when heat is used, but it is not obtained in the same quantity. It is milder, and may be kept longer without spoiling.

In a cold season of the year, a certain degree of heat is absolutely necessary. But if the oil is designed for aliment or medicine, the plates of the press should be heated in boiling water only. When the oil is intended for other uses, the plates may be made hotter, as heat expedites the separation of the oil, and gives a greater produce, but then care should be taken not to injure the subject by burning.

SOMETIMES the subject, when ground, appears almost like a dry powder. It is then said to be meagre, and requires to be exposed to the vapours of boiling water, which is done either by tying it up in a bag, or putting it into a sieve, and placing it over the steam. By this impregnation, it will yield its oil more readily, and in greater quantity. The oil may be easily freed from any water that may happen to be pressed out with it, as a spontaneous separation between them will take place on standing for some time.

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For the encouragement of those, who may choose to improve this subject, it may be proper to observe, that all the oils, from whatever vegetable substances they are drawn, when obtained by expression with due caution, agree in their general qualities, and are constantly mild, even tho' they are obtained from very acrid substances. Thus the expressed oil of mustard seed is, when fresh, as mild as that of olives, and the bitter almond, or peach kernel, affords an oil, by expression, as mild as that of sweet almonds. It is upon this principle, that the sun-flower oil may prove equally valuable with the best Florence oil, for diet or medicine. For every expressed oil, when pure and fresh, is void of acrimony, and free from any particular taste or smell.

BESIDES the mild oil just mentioned, some substances contain another kind of oil, called its essential oil, a part of which may be drawn off with the mild expressed oil, so called, and impart its smell or taste to that oil. It is called essential oil, from its yielding the particular odour of the vegetable, or part of the plant, from which it was obtained; it is pungent to the taste, and soluble in spirits of wine, which the other is not. They may therefore be easily distinguished from each other.

THE oil of sweet almonds, and the oil of olives, being pure unctuous expressed oils, not soluble in spirits of wine, but mild to the taste, and void of odour, very soft, emollient and lenitive, are chiefly used in medicine and diet. And the reason why the oil of olives, in particular, is preferred, is because it is less expensive, and will keep a much longer time without becoming rancid.

PERHAPS, on trial, the sun-flower seeds may be found to contain an oil that will answer the like good purposes with the salad and medicinal oil, now in use. If so, it will have this advantage over that of almonds or olives, that it is a native of the country, may be always had fresh, and at a small expence. Whereas the others are the produce of distant countries, bear a high price, and are often adulterated on that account; or being kept a long time, they lose their mild quality, and become rancid and acrimonious.

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THE practicableness of getting oil among ourselves at a moderate expence, and the importance of using it fresh, together with the probable uses of sun-flower oil for varnishes, for the basis of ointments, and for mixing of paints, as well as other purposes to be answered by oils in general, claim our attention to this subject, and encourage further trials of the like kind.

BEFORE we quit this subject, it may not be amiss to mention, that castor oil is justly celebrated for its medicinal qualities: The plant, from the seeds of which it is got, may be easily cultivated in this country, and the encrease of it is very great in a short time; might it not then be worth the attention of our farmers to propagate this plant, for the sake of its oil? We would just suggest, that perhaps it might be worth while to try whether the seeds of sumach, with which this country abounds, or of the mullen, which grows in old fields, and bears a great quantity of seed, would not yield, by expression a valuable oil for medicine, or other purposes.

*Mr. JOHN MOREL's Letter, with a Keg of BENE SEED.
Read before the Society, May 20, 1769.*

Savannah, 5th May, 1769.

*To Mr. CHARLES THOMSON, Secretary of the American
Philosophical Society, at Philadelphia.*

S I R,

I SEND you a small keg of Bene or Bene Seed, which you will please to present to your Society for their inspection. This seed makes oil equal in quality to Florence, and some say preferable. Some say one hundred weight of seed will produce ninety pounds of oil, others say less, be that as it will, it certainly makes very fine oil, and produces amazingly. If it is put to the trial, care should be taken to have the press well cleaned, so as leave no tincture from what may have been

H h 2

already

already pressed; in my opinion, this is an article of consequence, and I believe it will grow in Philadelphia. The way to sow it is in holes about three feet asunder, dropping in each hole about ten grains; when it comes up, thin it to three or four of the most promising, the seeds will appear in pods about September, and should, when full grown, and before dry, be gathered in. The method is as follows: As soon as you perceive about three-fourths or four-fifths of the pods rise on the stalk, and the lower pods begin to lose their seeds, it is then time to take it in; for after that, as much as ripens one day a top, so much falls out of the pod at bottom, you take a sharp hatchet bill or some such weapon, and with it cut off the stock twelve to eighteen inches below any of the seed, holding the stock with the left hand; and when cut, a second person receives it, keeping it upright, till he has his load, for if you turn it downwards the ripe seed will fall out of the pods, you may immediately carry it into a barn, and set it upright on a close floor till you perceive all the pods fully dry and open. (You may, if you chuse, leave it in the field, which must be the case if a large quantity is planted,) then thresh it, and run it through a proper sieve, and it is fit for use.

I AM quite unacquainted with the method of expressing the oil, but I believe if it is designed for table use, nothing should be done to the seed, as it might give it an ill taste. The lighter and dryer the soil is in which it is planted, the better.

I am,

Dear S I R,

Your most humble Servant,

JOHN MOREL.

A Let.

A Letter from Mr. HENRY HOLLINGSWORTH, to the American Philosophical Society, held at Philadelphia, &c.

Read before the Society, 17th of February, 1769.

GENTLEMEN,

THE laudable design with which you seem actuated to promote the good of your country, and the earnest desire you have expressed in the public papers, to be informed of whatever may tend to that purpose, induce me to lay before you such experiments as I have made and found effectual to destroy *the wild garlic*, with which the country is in many places infected, and which is very pernicious to the grain. If what I offer, shall meet with your approbation, and be judged worthy the attention of the public, you are at liberty to communicate it in such a way as you shall think most proper. For my own part I shall think myself happy if my experience may, by your means, be made useful to my country.

IN 1753, I fallowed and sowed with wheat, a field of about 50 acres, the greatest part of which was very full of garlic; I fallowed in May, stirred in August, and sowed in September. In April 1754, I perceived the wheat much choaked with garlic, and at harvest found in many parts of the field almost every tenth head was garlic, which rendered the wheat unfit for use, until by immersing it in tubs of water the garlic (which floats) was separated from it. But though the wheat, if carefully dried, receives little injury from this immersion, yet the trouble attending it is so great, as to discourage farmers from raising large crops. In April 1755, I planted the same field with Indian-corn, and had a good crop. In April 1756, I sowed the same field with oats, in August I ploughed down the oat stubble; and in September sowed a crop of wheat. In April 1757, I was agreeably surprized at seeing but very little garlic, and that small and dwindling; and at harvest there was scarce a head to be found, except along the side of the fences. The success of this culture, which was merely accidental, and done without any view of destroying the garlic, induced me to try the following experiment.

IN

IN April 1758, having fixed on a field for my next fall crop, which had produced Indian-corn the year before, and was equally full of garlic with that I mentioned before; I sowed part of it with oats, the other part I fallowed in June, and stirred in August, at which time I plowed in the out stubble, as before, and sowed the whole in September, causing the same ridge to pass through part of the stubble and part of the fallowed land. In April 1759, there was a very perceivable difference. The stubble part was green with wheat, but the fallowed part was of a bluish colour, occasioned by the quantity of garlic, and at harvest was full of large heads, while in the stubble part there was not one to be found.

SINCE that I have continued to sow oats in the garlicky lands designed for wheat, and find I have succeeded so well in destroying the garlic, that after three years culture in that way, the lands may be fallowed and sown with wheat in the usual manner, without any danger from that noxious plant.

SEVERAL of my neighbours have pursued the same method and find it answers. As the advantage of a crop of oats is more than equal to the difference between fallow and stubble ground wheat (where the land is tolerably good) I would recommend it to all who are troubled with garlic to make a trial. The only disadvantage will be the impoverishing their lands, which, if they have manure, may be easily remedied. At the same time, I would observe, that the stubble which is ploughed down serves for a manure, and nearly repairs the waste occasioned by the crop of oats.

IF it be asked why oats destroy garlic, I must confess I am unable to resolve the question. Perhaps ploughing the land in the month of April, when the greatest part of the oil of the root or clove is in the shoot, and turning it under at that time, destroys the roots more effectually than at any other season, and the mowing the oats, which is the method pursued by us, destroys the heads that would otherwise come to seed later in the year. Possibly the same tillage in the same

same season without sowing oats, might answer the end proposed. But having never made the experiment I can say nothing certain on that head.

I am, &c.

H. HOLLINGSWORTH.

Head of Elk, Nov. 30, 1768.

Extract of a Letter from Mr. PETER MILLER, of Ephratah, to Mr. CHARLES THOMSON, on the time of sowing PEASE, so as to preserve the Crop from being worm-eaten.

“ THE pease I send you the sample of are the produce of
 “ last summer. Their seed was very much worm-eaten,
 “ but as the crop produced from them was no way infected,
 “ it is evident that their safety depended entirely on the time
 “ of sowing; which is about the 10th of June, new style.
 “ This hath been confirmed to me by a farmer here of a long
 “ experience.

“ THE best method would be to begin sowing towards the
 “ latter end of May, and continue for a few weeks, sowing
 “ some each week, or at the distance of 3 or 4 days, in order
 “ to discover whether the worm does not come from sowing in
 “ an improper season. Some Albany pease might likewise be
 “ tried as seed; all which I recommend to the prudent con-
 “ sideration of your society. For, if you could make any sure
 “ discovery for the use of the country, the public would be
 “ greatly indebted to you.

“ PEASE were heretofore very plenty in Pennsylvania. I
 “ knew one farmer in Oley who raised sixty bushels at a crop,
 “ and I did not hear that they were damaged at that time by
 “ the worm. I must not forget to tell you, that, as the pease
 “ I have sent you are of an excellent kind, and very scarce
 “ here, you will be careful to propagate their species. As
 “ to the *lentiles* which are sent, the time of sowing them is
 “ early in the spring, and most commonly with oats.”

N. B.

N. B. It is recommended to such as shall make experiments of sowing pease late, in order to have a crop free from the worm, that they would keep an account of the times of sowing, and the effect thereof, in regard to their crops.

An easy Method of preserving SUBJECTS in SPIRITS.

By Mr. LEWIS NICOLA.

PERSONS curious in preserving Specimens for Natural History are often disappointed by the evaporation of the spirits, which occasions the loss of the subject intended to be preserved, or they must be very careful in often examining their bottles, or putting spirits in such as they find have occasion for a fresh supply, which, in a large collection requires much time, trouble, and expence. This induced Mr. de Reaumur to try many experiments, in order to obviate this inconvenience; which he gave to the public in a long dissertation, inserted in the Memoirs of the Royal Academy of Sciences, for the year 1746, after mentioning his different trials, he recommends two methods.

THE first is, to get bottles with glass stoppers of a conic form in the part that enters the neck of the bottle, and broad and flat at the other end. When the spirits and specimen, supported by a piece of wire, are put in, a little Mercury must be thrown into the bottle, and the stopper fixed in its place, and secured by a piece of bladder or leather tied round it and the neck of the bottle; the whole must be reversed and placed on the broad end of the stopper, which occasions the Mercury to settle between the neck of the bottle and stopper, and obstructs the evaporation of the spirits by the only passage through which the fine parts could fly off. He says, nut oil, thickened to the consistence of honey, by a long exposure to the air which will give it weight sufficient to sink in a weak spirit, may supply the place of Mercury.

THE second method is, for bottles that have not glass stoppers for which he recommends a layer, of about two lines thickness

thickness on the inside of the bladder, which is to cover the mouth of the bottle, of nut oil prepared as before directed, and when the bladder is well tied on, the bottle may be reversed without any hazard, but great care must be had to wipe the edge of the bottle very dry, that the oil may adhere to it in every part. As many bottles will not stand on their mouths, Mr. de Reaumur directs their being placed in wooden cups, turned with a broad bottom and a hollow, sufficient to receive the neck of the bottle.

THESE two methods, though well calculated to answer the end proposed, have some inconveniencies. In the first the bottles must be designedly made for this use and of flint, that the stoppers may be ground into them, which, with the cost of the Mercury, is a considerable expence, besides the difficulty persons at a distance from a glass house will find, in procuring them. In the second, the preparing oil, so that it may thicken to consistence of honey, is a work of years, the operations may be much shortened, by putting the oil about two lines thickness in leaden vessels, as that metal has a considerable effect on the oil, which may by this means be sufficiently prepared in three or four months.

AFTER several experiments, I found two methods free from the above inconveniencies, and which I have great reason to think will answer the purpose fully from four or five years experience.

THE first method has some affinity with Mr. de Reaumur's and is as follows. When the subject and spirits are put into the bottle, carefully wipe the inside of the neck and edge till quite dry, prepare some thin putty, of the consistence of a soft ointment, and put a coat of it about a line or two thick on the side of the bladder or leather, which is to be next to the bottle, and tie it tightly about the neck, place the bottle with the mouth downward in a small wooden cup, and fill it with melted tallow, or tallow mixed with wax, until all the bladder or leather cover is buried in it, and the tallow adheres to the sides of the neck; this will effectually prevent the fine parts of the spirits from flying off. Great care must be taken to have the

edge of the bottle very dry, and if rubbed with a feather, dipped in oil, it will be better, and in filling the cup, to have the tallow no hotter than is barely necessary to make it fluid.

THE second method is, after the specimen and spirits are put into the bottle, dry the inside of the neck and edge thoroughly, and anoint them with a feather dipped in oil, stop the bottle with a cork well fitted and steeped in oil, till it has imbibed as much as it can contain, cover the cork and edge of the bottle with a layer of putty prepared as directed above and tie a piece of soft leather or bladder over the whole.

OLIVE, or any other fat oil, is to be preferred to such as dry easily; I would also recommend the use of spirits of a moderate strength, as those that are very strong burn up and discolour the specimens, particularly such as have fine colours. These two methods have the advantage of Mr. de Reaumur's, in the smallness of the expence and easiness to procure the materials. For specimens that it will not be necessary at times to take out of the bottles I would recommend the first method, as more obstacles are opposed to the evaporation than in the second, besides the cup, the cost of which is very trifling, puts the bottle in less danger of being upset and broken, than most bottles are when standing on their bottoms.

A Letter from Bethlehem, dated 23d July, 1769. With a Receipt for making CURRANT WINE.

Read before the Society.

DEAR SIR,

ESTEEMING it a duty incumbent on the Members of civil Society, to communicate every useful discovery they conceive the Public may be benefited by, I take the liberty of sending you the inclosed Receipt for making Currant-Wine, which, for a good number of years, has been successfully carried on in this place.

FROM

FROM its cheapness, (which I imagine cannot stand the maker in more than Six-Pence a quart ;) from the easy culture of the shrub, and the consideration of their never failing to bear ; it is thought the inhabitants of this province may be generally induced to fall into the way of making it, whereby, perhaps in time to come, the great importation of the inferior sorts, and I fear, before they come into the hands of the retailer, bad wines may be greatly lessened, if not wholly prevented, and a wholesome liquor as the Currant Wine, if well made, and of proper age, really is, introduced in their stead, which I need not add would be a great saving to the Province.

THE Currant bush, though a shrub that grows almost spontaneously, requires nevertheless some dressing ; in regard to which the following directions may be of service.

PLANT them round the quarters in your garden, that they may have the benefit of the dung and culture annually bestowed thereon, which will consequently make the berries large and the juice rich.

THE *Red Currant* is preferable to the *White*, as yielding richer juice, and in much greater quantity.

TAKE the most luxuriant slips or shoots of a year's growth, set them in the ground about eight inches deep, and not less than twenty-four distant from each other ; these never fail of taking root, and generally begin to bear in two years. For the rest let them from time to time be treated as espaliers, (but not against a wall) observing to keep the roots, especially in the spring of the year, free from suckers and grafts.

THIS treatment is the more necessary, in that the goodness of the Wine in a great degree depends on their having the full benefit of the Sun and air, to mature and give the berries a proper balsamic quality, by exhaling a due proportion of their acid watry particles.

The Receipt for making CURRANT WINE.

GATHER your Currants when full ripe, which will commonly be about the middle of July; break them well in a tub or vat, (we have a mill constructed for the purpose, consisting of a hopper, fixed upon two lignum vitæ rollers,) press and measure your juice, add two thirds water, and to each gallon of that mixture (i. e. juice and water) put 3 lb. of Muscovado sugar, (the cleaner and dryer, the better, very coarse sugar first clarified will do equally well,) stir it well, till the sugar is quite dissolved, and then run it up. If you can possibly prevent it, let not your juice stand over night, as it should not ferment before mixture.

OBSERVE, that your casks be sweet and clean, and such that never have had either beer or cyder in them, and if new, let them be first well seasoned.

Do not fill your casks too full, otherwise they will work out at the bung, which is by no means good for the Wine; rather make a proportionable quantity over and above, that, after drawing off the Wine, you may have a sufficiency to fill up the casks.

LAY the bung lightly on the hole, to prevent the flies, &c. from creeping in. In three weeks or a month after making, the bung-hole may be stopped up, leaving only the vent-hole open till it has fully done working, which generally is about the latter end of October. It may then be racked off into other clean casks, if you please, but experience seems to favour the letting the Wine stand on the lees till spring, as it thereby attains a stronger body, and is by that means in great measure divested of that sweet, luscious taste, peculiar to made Wine; nay, if it is not wanted for present consumption, it may, without any damage, stand two years on the lees.

WHEN you draw off the Wine, bore a hole an inch, at least above the tap-hole, a little to the side of it, that it may run clear off the lees. The lees may either be distilled, which will yield a fine spirit, or filtered thro' a Hippocrates's sleeve, and returned again into the cask. Some put in the spirit, but I think it not adviseable. Do

Do not suffer yourselves to be prevailed on to add more than one third of juice, as above prescribed, in hopes the Wine may be richer, for that would render it infallibly hard and unpleasant, nor yet a greater proportion of sugar, as it would certainly deprive it of its pure vinous taste.

By this management you may have Wine, letting it have a proper age, equal to Madeira, at least superiour to most Wines commonly imported, and for much less money.

In regard to the quantity of Wines intended to be made, take this example, remembering that 12 lb. of sugar is equal to a gallon of liquid.

For instance, suppose you intend to make 30 gallons only,

then there must be,	
8 gallons of juice,	24 gallons of mixture,
16 of water,	3 multiplied by

24 gallons of mixture	12) 72 pounds of sugar, equal to
6 gallons produced by sugar	6 gallons of liquid.

30 gallons.

AND so proportionably for any quantity you please to make.

THE common cyder presses, if thoroughly clean; will do well in making large quantities, the small hand-screw press, is most convenient for such who make less.

N. B. AN extraordinary good spirit, for medicinal and other uses, may be distilled from *Currant-Juice*, by adding a quart of molasses to a gallon of juice, to give it a proper fermentation.

Extracts

Extracts of a LETTER from Dr. LORIMER, of West-Florida, to HUGH WILLIAMSON, M. D.

Read before the Society, 21st April, 1769.

WHEN I read the plan for enlarging your Society, one part of it particularly called to my mind an introduction to the conclusion of the modern part of the Universal History, wherein the geography of this globe is considered in a new light, with a view to discoveries. In that article it is observed, that the lines which measure the greatest length of the old and of the new continents are nearly equal, and that they incline to the equator in the same angle, but in opposite directions. It is farther remarked, that each of them divide their respective continents into two tracts of land almost of the same superficial contents, and that these continents seem fixed by nature as a counterpoize to one another. Your Society take notice of the similarity between the east side of the old continent, and the east side of the new, in vegetable productions, &c. and vice versa. Now let me contribute one proof of this proposition amongst many others. The odoriferous Skimmi of Japan is a native of West-Florida. Our agent is a great naturalist, and particularly intent on procuring specimens of this plant. I hope in a little time to be able to give you and him a pretty satisfactory account of it. We have a variety of shrubs, with aromatic and odoriferous bark. I am really of opinion that the common plants have a more exquisite flavour in this climate than in other countries. There is a kind of sarsaparilla, which answers the intention, but I question whether it would sell well at first. We have snake-root and many other medicinal plants, and I do not doubt but some articles may be discovered which are yet unknown in the Materia Medica. There is a beautiful kind of bean, which some of our sailors having eat of, were surprized with a vomiting and purging, just as another crew were by eating poke for sallad. There is likewise a plant of the pea kind, said to be used by the Indians as an universal remedy in venereal cases. I hope soon to be better acquainted with these things: Though I am sorry to say that I am no great botanist, nor have we any man
of

of eminence in that way. Here is certainly a great field to employ naturalists. Minerals, especially iron, we have in abundance. I have a very good natural magnet, found within six miles of this town. There is an excellent chalybeat water just by, its elastic spirit has driven the cork out of the bottle which contained it. The country is full of navigable rivers, and runs of the finest fresh water. About Mobile and at the swampy mouths of some rivers, it must be a little unhealthy, but it is far from being so bad as has been imagined. In April 1765, when I was notified as surgeon to the forces here at the war office, I unluckily prognosticated the fate of our troops which were then to be sent out. It is now evident that it was misconduct entirely that occasioned the loss of so many soldiers and subjects. I am just making out a state of the medical constitution of this climate; as an introduction to which I have given a short general account of the situation of the country and the temperature of the air; for which last purpose I have taken the height of the thermometer generally three times every day for one whole year, and I have noted all the extraordinary variations for almost three other years. Nothing else could give an idea of a climate, where the thermometer will rise or fall sometimes 20 degrees in a few hours, and at other seasons not 2 in many days, the extremes being at least from 17 to 98 degrees of Farenheit's scale. Your Society observe, that on the East Coast of North-America and of China, the North-West Winds are cold and piercing, the South-West warm and dry, the North-East cold and wet, the South-East wet but warm; and that the case is different on the West Coast of Europe and at California. Now on this Coast, which is neither the East nor West side of a continent; in winter the Southerly Winds are warm and moist, the Northerly cold and dry: In summer we have the daily sea breeze from the South, and in the night or morning a refreshing gentle land wind from the North. The sky in this country is remarkably serene, especially when the winds are Northerly. A thought just strikes me, that, according to the foregoing similarities, our coast should resemble that of Persia from the river Indus to the gulph of Ormus, but as there is no Mississippi on that coast, we may compare the mouths of that river with those of the Ganges, and the country about Bengal, to that of New-Orleans.

Orleans. The Spanish Main, as we call it, shall be Arabia, and Spirito Sancto, in East-Florida, may represent Madras. However, to return to what we know of our own situation. The Gulph of Mexico may be considered as one great whirlpool. The general course of the waters in the Great Oceans, as well as the current of the Air within and near the Torrid Zone, being from East to West; the force of the Atlantic comes upon the West-India islands, and the lengths of these islands are in that direction. When the waters get into the Great Gulph, they are obstructed every where, and as it were turned round by the land, the greatest velocity of this great body of water will be towards the Equator, and it must get out where it meets with the least resistance, that is on the side towards the Pole, and there it forms the strong current or passage, called the Gulph of Florida. The natural course therefore of the waters on our coast, should be from West to East; but here there are frequent currents which are very irregular, depending most probably on the winds, but seldom on that which blows on the spot. By the general law of the tides, there should be flood for one six hours, and ebb for the six following nearly, but here an ebb-tide will continue for eighteen or twenty hours, and the flood only four or six, & viceversa. A southerly wind always raises and keeps up the waters in our bays, and the northerly winds almost empty them, yet it must be allowed that these ebbs and floods are not equable during this continuance, for upon accurate observation there is a tendency to two ebbs and as many floods every twenty four hours, though they are overpowered by the winds or currents. The entrance of our bays and rivers are defended as it were by a shallow or sand bank, which forms a bar farther out towards the sea, than is usual in Europe; the depth on the bars is not at all proportional to that within the rivers: All the rise on the bars is about a foot, while in the bays it is almost three. The mouths of our rivers are frequently divided into different channels by a kind of swamp covered with reeds, and all this is most probably occasioned by a kind of conflict between these currents, and the rising of our rivers at certain seasons of the year. There are no dangerous shoals on this coast, unless you fall too far to the Eastward about Cape-Blaze, or St. George's Islands. The latitude of the Cape being the most southerly land

land in West-Florida is about $29^{\circ}. 40'$, and from thence to the entrance of Sancta Rosa bay, which is in $30^{\circ}. 30'$ the land gradually declines to the North. From Sancta Roza to the entrance of Mobile Bay in lat. $30^{\circ}. 17'$ it falls again to the Southward; and from Mobile Bay to the entrance of the lakes it is nearly East and West. There is no such thing as recommending any map of this country. Bellin and such as have copied from him, give some resemblance of the coast, but they are all erroneous, and that in very material articles. If Mr. Gaulds's surveys are not soon published, he will possibly send a copy of them for your Society, but he is just now so engaged that he cannot set about such a work. Thus far I think it necessary at present to inform you from his papers; that the bay of Spirito Sancto is sufficient for first rate ships, but that is in East-Florida. The harbour of Pensacola will only admit such as draw 21 feet water, though that is sufficient for 50 or 60 gun ships, and there is a road sted lately discovered behind the Chandeliers, which is much more commodious than that at Ship Island in its neighbourhood; it will admit vessels of any size, and is sheltered from all winds except the North and North-West, in which cases they can easily put to sea, and make for Pensacola or Spirito Sancto, if necessary. The bay of St. Joseph is not unlike that published by Jeffereys, it has 18 feet water good, fine anchorage, and would be a most advantageous situation for a fishery, salt pans, &c. The bay of St. Andrew just adjacent is as much larger as it is unlike to any thing yet published, it extends from South-East to North-West, and is a most commodious harbour for vessels of 13 feet draught. The bay of Sancta Rosa is still more extensive; it lies from South-West to North-East, but can easily answer for the Pensacola pettiangers, which by the long channel within the island, and the river which falls into the head of the bay, and extends North East almost to the Lower Creek Nation, may trade with the Indians. The lands upon this river at some distance from the bay are good, but all along this coast there is little else than a sandy beach and pine barren. But for a description of the rivers Mississippi, Pearls, Pascogoula, the Tombecby, and Albama, which fall into the bay of Mobile, the bay and river of Perdido, just contiguous to Pensacola,

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the Scamby, and so forth, I refer you entirely to Mr. ———, who is a much better judge than I am of the advantages which may be made of their produce, &c.

I SHALL send you a description of an Universal Magnetic Needle. It gives the variation and dip at the same time, the last of which I presume with more accuracy than any yet extant. It answers in all parts of the world, without the addition or alteration of any poise, such as our best compasses now have. A collection of American magnetical observations is much wanted; with the course of the line of no variation in-land, and the dip, which I imagine will be found greater than in the same latitudes on the European side. The farther to the North and West, that the observations could be made the better. This was a subject which I had despaired of ever seeing reduced to any kind of regularity, but I am now well satisfied that it may. I have great expectations from the plan of your Society, and shall make it my business to prepare something or other, by the time I can expect to have the favour of a few lines from you. I most sincerely wish you success, and am, Sir,

Your most obedient

Humble Servant,

J. LORIMER.

Pensacola, Jan. 7, 1769.

A Catalogue of such FOREIGN PLANTS, as are worthy of being encouraged in our American Colonies, for the Purposes of Medicine, Agriculture, and Commerce.

[From a Pamphlet by JOHN ELLIS, F. R. S. Presented by the Honorable THOMAS PENN, Esq; to the American Philosophical Society, thro' the Hands of SAMUEL POWEL, Esqr.]

To avoid confusion in the Botanical names, both the generical and specific, or trivial names of the Plants, are set down, with the page referred to in the celebrated Linnæus's second edition of his Species of Plants. Other Authors of the best authority are mentioned, where Linnæus is silent.

Latin Names.	2d Ed. L. Sp.	English Names.	Observations.
Rubia Peregrina	p. 158	Turkey Madder	The first is supposed to be same that is now cultivated in Smyrna for a crimson dye.
Rubia Tinctorum	p. 158	Dyers Madder *	
Quercus Suber	p. 1413	Cork-bearing oak	Grows in the southern parts of France, Spain, and Portugal.
Quercus Ægilops	p. 1414	Avellanea or Valenida oak	The cups of the acorns, which are very large, used here in dying, grow in Greece and Natolia, particularly in the island of Zia in the Archipelago, where Tournefort says they gather in one year 5000 Cwt.
Quercus Gallifera	Parkinson, 1386	Gall-bearing oak	Galls from Aleppo and Smyrna. This oak is not yet known in England: The Acorns may be brought over in wax, and sent to the Floridas, Georgia, and South-Carolina.

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Carthamus

* This plant is a native of the warmest parts of Europe, and is better calculated for the climate of the Floridas than either of Holland or England, where it is cultivated; but principally in the former, from whence we are chiefly supplied with this valuable dye. The chemists say, and with reason, that the warmth of the climate exalts the colour. If so, it may be well worth the attention of the public to encourage the planting of so valuable an article of commerce in a climate and soil that seems so much better adapted to it, where the land is cheap, and where vegetation is so much quicker and more luxuriant; and while we encourage the growth of it in our colonies, we may have the advantage of manufacturing this valuable commodity at home, for which at present we pay sums scarcely credible, to the Dutch.

Latin Names.	2d Ed. L. Sp.	English Names.	Observations.
<i>Carthamus Tinctorius</i> }	Lin. Sp. 1162	Safflower	Much used in dying, grows in Egypt.
<i>Rhamnus catharticus minor</i>	Tournst. 593	Buckthorns that produce yellow berries of Avignon.	Used by painters and dyers; both these plants produce berries fit for this purpose.
<i>Rhamnus Saxatilis</i>	Lin. Sp. 1671		
<i>Olea Europea</i>	p. 11	Olives of several varieties.	For oil: these grow in France, Spain, and Italy. Young plants and ripe fruit of the French and Spanish sorts, may be brought from thence.
<i>Sesamum Orientale</i>	p. 883	Oily grain	Propagated in the Levant for oil, which does not soon grow rancid by keeping.
<i>Gossypium herbaceum</i> }	p. 975	Two sorts of annual cotton	Both these kinds of annual cotton are yearly sown in Turkey, and would grow well in the warm climates of North-America, as the Floridas, Georgia, Carolina, and Virginia.
<i>Gossypium hirsutum</i>			
<i>Salsola Soda</i> }	p. 323	These kinds of glasswort for Barilla.	These are sown yearly in fields near the sea in Spain, for making Barilla, for soap, glass, &c.
<i>Salsola Sativa</i> and <i>Chenopodium maritimum</i>	p. 321		
<i>Ceratonia Siliqua</i>	p. 1513	Locust-tree or St. John's Bread	The pods are excellent food for hard-working cattle, and used for this purpose on the sea-coast of Spain, where they are easily propagated from seeds or cuttings.

Pistachia

Latin Names.	2d Ed. L. Sp.	English Names.	Observations.
Pistachia Vera	p. 1454	Pistachia-tree	They are propagated about Aleppo, where the female or fruit-bearing ones are ingrafted on stocks raised from the nuts.
Pistachia Terebinthus	p. 1455	Chio turpentine-tree	This kind of turpentine is used in medicine.
Pistachia Lentiscus	p. 1455	Mastick-tree	Gum Mastick from the isle of Scio; as this tree, commonly called the Lentiscus, is doubted to be the genuine Mastick-tree, seeds of the true kind may be procured from the isle of Scio.
Styrax Officinale	p. 635	Gum Storax tree	This tree grows in Italy, Syria, and India; but the warmer climates yield the best gum.
Convolvulus Scammonia	p. 218	Gum Scammony	Seeds of the Plant, from whence this excellent drug is procured, were sent into England about 20 years ago, from Aleppo, by the late Dr. Alex. Russel: it bears this climate very well, and produces seed in hot summers; but requires the warmer climates of Carolina, Georgia, and the Floridas.

* There is a resinous juice, which, by age, hardens into a solid brittle resin, of a pungent, warm, balsamic taste, and very fragrant smell, not unlike the Storax calamita, heightened with a little ambergrise, which is produced from the Styrax aceris folio of Ray, or Liquidambar Styraciflua of Linnæus, Spec. plant. 2418, which grows in perfection in the Floridas. This, Dr. Lewis, in his Materia Medica, p. 353, says, might be applied to valuable medicinal purposes.

The French, in Du Pratz' History of Louisiana, speak with rapture of its healing qualities, and the high esteem it is in among the Indians of Florida, on account of its infinite virtues: it is known to the English by the name of the Sweet Gum-tree, and to the French by the name of Copalm. This is well worth the attention of the College of Physicians, as we can have it genuine, whereas the Storax from the East is often adulterated.

Latin Names.	3d Ed. L. Sp.	English Names.	Observations.
Papaver Somniferum	p. 726	True opium poppy	ridas, to make the gum-refin that flows from it a beneficial article of commerce. It is so frequently adulterated in Turkey, that, in order to have it genuine, it is well worth propagating in our colonies. This is recommended to be sown in our southern colonies of North-America, for the sake of obtaining the opium pure. ¶
Cassia Senna	p. 539	Alexandrian purging Senna	This grows in Upper-Egypt, and is brought from thence to Alexandria; it would not be difficult to procure the seeds of this useful drug.
Croton Sebiferum	p. 1425	Tallow tree of China	This plant grows in moist places in China, and is of great use in that country.
Rheum Palmatum	p. 521	True Rhubarb	The seed of this plant was brought to England about five years ago, by Dr. Mounsey, F. R. S. from Moscow, and appears by experiment to be the genuine true Rhubarb of the shops, and is a most valuable acquisition to this country, as it will grow well in a deep rich soil, inclining to a sandy or gravelly loam, but not in too wet a situation ¶ The seed of this species of poppy is recommended by a physician of great eminence as proper for the same purposes in medicine as sweet almonds are used. It is observed not to have the least degree of a narcotic quality in it.

Latin Names.	2d Ed. L.Sp.	English Names.	Observations.
Calamus Rotang	p. 463 *	Three sorts of	ation, and may be cul-
Pterocarpus Dra-	p. 1662	Gum Dragon,	tivated both here and
co		or Dragon's	in North-America. Mr.
Dracæna Draco	Lin.Syst.Ed.	blood.	Inglish has raised this
	12. p. 246		plant with so much suc-
Dolichos Soja	Lin.Sp. 1023	A kind of kid-	cess at his country-
		bean called	house at Hampstead, as
		Daidfu	to be able not only to
Laurus Cassia	p. 528	Cassia-Lignea tree	produce some excellent
			good Rhubarb, but a
			sufficient quantity of ripe
			seed to make a large
			plantation; and at the
			same time has most ge-
			nerously bestowed a
			great deal of seed to be
			sent to our American
			colonies, where, no
			doubt, but it will prove
			in a few years a most
			beneficial article of com-
			merce.
			1. From a kind of cane
			in the East Indies. 2.
			From Java and Surinam.
			3. From the Canary
			and Madeira islands.
			Used for making Soye &
			or Indian Ketchup.
			See Kæmp. Amœnitat.
			Grows in Sumatra.
			Laur.

§ The method of preparing East-India Soye, or India Ketchup.

Take a certain measure, for instance a gallon, of that sort of kidney-beans, called Daidfu by the Japonese, and Caravances by the Europeans; let them be boiled till they are soft; also a gallon of bruised wheat or barley, (but wheat makes the blackest Soye) and a gallon of common salt. Let the boiled caravances be mixed with the bruised wheat, and be kept covered close a day and a night in a warm place, that it may ferment. Then put the mixture of the caravances and wheat, together with the gallon of salt, into an earthen vessel, with two gallons and an half of common water, and cover it up very close. The next day stir it about well with a battering machine or mill (Rutabulum) for several days, twice or thrice a day, in order to blend it more thoroughly together. This work must be continued for two or three months, then strain off and press out the liquor, and keep it for use in wooden vessels; the older it is the clearer it will be, and of so much more value. After it is pressed out, you may pour on the remaining mass more water, then stir it about violently, and in some days after you may press out more Soye.

Latin Names.	2d Ed. L. Sp.	English Names.	Observations.
<i>Laurus Cinamomum</i>	p. 528	Cinnamon-tree	In Ceylon, Guadaloupe, and in most of our newly ceded islands.
<i>Laur. Camphora</i>	p. 528	Camphire-tree	In Japan, and in Sumatra, now in England in the green-houses about London. It will grow freely where oranges and lemons do.
<i>Cycas Circinalis</i>	p. 1658	Sago Palm-tree	In Java, and the warmest parts of the East-Indies.
<i>Amyris Gilcadensis</i>	Lin. Mant. 165	True balm of Gilcad-tree. †	Lately discovered in Arabia by Dr. Forskall, and described by Dr. Linnæus in a late dissertation.
<i>Arundo Bambo</i>	p. 120	The true Bamboo cane	Of great use in China, and might be also in our American islands.
<i>Anacardus Orientalis</i>	Kæmpfer Amœn. p. 793	Siam varnish tree, called Ton-rack by the Japonese	The fruit of this is the Malaca bean, or marking nut, and the Oriental Anacardium of the shops. This is the common

|| The camphire from Sumatra is greatly preferable to that of Japan; we are not certain whether it is from a different species of tree, but it seems well worth inquiring into, as the effects of proportionable quantities in medicine are surprizingly different, perhaps it may be owing to the great difference of heat in the climates.

† We have in the island of Jamaica, a species of tree of this genus, called by Linnæus *Amyris balsamifera*. See *Species Plantarum*, p. 496. Sir Hans Sloane, in his *hist. of Jam.* vol. II. p. 24, calls this tree *Lignum Rhodium*, from the odoriferous smell of its wood when burnt, which it diffuses a great way; for which reason he believes it to be the tree that afforded the agreeable scent which Columbus perceived on the south shore of Cuba, upon the discovery of that island, as is mentioned by several historians. Dr. Pat. Browne, in his history of Jamaica, p. 208. calls this tree white candlewood, or rosewood, and commends it much; he says it is very resinous, burns freely, and affords a most agreeable smell; and that all the parts of this tree are full of warm and aromatic particles. — Quere, Whether it is not worth while to extract the balsam, as it agrees so near in character and genus with that most valuable drug the balsam of Mecca?

* The French had brought this most useful plant from the East-Indies to their West-India islands: a few roots have been got from thence to Grenada, and will perhaps in time become familiar in our islands. But too much pains cannot be taken in the propagation of this plant, as its uses are manifold and extensive, both in building, and all kinds of domestic instruments.

Latin Names.	2d Ed. L.Sp.	English Names.	Observations.
<i>Thea</i>	p. 734	Tea	common varnish of the East-Indies, as described by Kämpfer. This tree is unknown to the Botanists.
<i>Gardenia Flori-da</i>	p. 305	Umky of the Chinese	From Japan and China: See Kämpfer's Amœnitates, p. 60 ¶.
<i>Magnifera Indica</i>	p. 290	East-India Mango-tree	Used in dying scarlet in China. The pulp that surrounds the seeds, gives in warm water a most excellent yellow colour, inclining to orange. See Phil. Transf. Vol. 52. p. 654, where there is an exact figure of it.
<i>Morus papyrifera</i>	p. 1399	Paper Mulberry-tree	This excellent fruit is much esteemed in the East-Indies, and it is said there is a tree of it now growing in the island of Madeira. By the description which Dr. Solander gives of this fruit, at Rio Janeiro in Brasil, it is not so good as the East-India fort.
			Used for making paper in China and Japan. See Kämp. Amœnit. p. 467. This has been some time in the English gardens.
		L 1	Cinchona

¶ It is asserted by some people, that the green tea and the bohea tea are two different species; but without foundation: they are one and the same species. It is the nature of the soil, the culture, and manner of gathering and drying the leaves, that makes the difference; for take a green-tea tree and plant it in the bohea country, and it will produce bohea-tea, and so the contrary. This is a fact attested by gentlemen now in London, that have resided many years in China, and who have had great experience in this article.

Latin Names.	2d Ed. L.Sp.	English Names.	Observations.
Cinchona Offi- cinalis	p. 244	Jesuits bark-tree	This grows at Loxa in the province of Peru; and could it be obtained so as to be cultivated in our American islands, would be of infinite advantage to us.
Dorstenia Con- trayerva	p. 176	Contrayerva-root	This grows in New-Spain, Mexico, and Peru.
Smilax Sarfapa- rilla	p. 1459	Sarfaparilla-root	It is brought from the Bay of Campeachy, and the Gulph of Honduras, where it grows in plenty, and might easily be propagated in Florida.
Copaifera Offi- cinalis	p. 557	Balsam Copaiva-tree	In Brazil, and Martinico.
Toluifera Bal- samum	p. 549	Balsam Tolu-tree	This tree grows near Carthagená, in South-America.
Hymenaea Cour- baril	p. 537	The Locust or Gum Copal-tree, for the finest transparent varnish.	This tree is known to yield the true Gum Copal, and that the difference between this and Gum Anime, may be owing to soil and heat of climate; it grows wild in our American islands, the Moskito shore, and in Terra Firma.
Jalapium Offici- narum	Dale 183	True Jalap	This plant is supposed by some to be a kind of Bindweed or Convolvulus, that grows near Mexico; by others it is thought to be a species of Marvel of Peru. As we are uncertain of the genus, it is well worth enquiring into, as a most useful drug, in order to propagate it in our colonies.

Latin Names.	2d Ed. L. Sp.	English Names.	Observations.
<i>Bixa Orellana</i>	Lin. Sp. 730	Arnotto, for dying	This grows in all the warm climates of America. The French cultivate it, but what the Spaniards send is much richer in colour and more valuable.
<i>Mimosa Senegal</i>	p. 1506	Gum Senegal tree	This grows in Ægypt, and in Senegal.
<i>Mimosa Nilotica</i>	p. 1506	Gum Arabick	In Ægypt, from whence the seeds may be procured.
<i>Ficus Sycomorus</i>	p. 1513	True Sycamore of Zaccheus	This is reckoned the most durable timber we know. The repositories of the Mummies found in Ægypt are made of this timber.
<i>Ficus Carica</i>	p. 1513	Turky Figs	Figs grow in the greatest perfection in Carolina, and would become a valuable trade if they had the method of curing them as in Turkey.
<i>Vitis Apyrena</i>	p. 293	Currants, or Corinthian grapes	The cuttings of this vine might be procured from Zant.
<i>Fraxinus Ornus</i>	p. 1510	Calabrian Manna Ash †	This is worth trying in our southern colonies, where the heats are violent in the summer. It is common in our nursery gardens.
<i>Amygdalus Communis</i>	p. 677	Sweet Almonds	These would grow to great perfection in our southern colonies.

L 1 2

Capparis

† There is no drug so liable to adulteration as this: and therefore, as it is a medicine so frequently in use among persons of tender constitutions, especially young children, great care should be taken to have it genuine.

Latin Names.	2d Ed. L. Sp.	English Names.	Observations.
<i>Capparis Spinosa</i>	p. 720	Caper tree	This shrub requires a rocky soil to grow in, as it is about Marseilles and Toulon.
<i>Punica Granatum</i> §	p. 676	Balaustians, or the blossoms of the double flowering pomegranate	This tree would thrive extremely well in our southern provinces, and yield a profitable article in their blossoms. Plants of this kind are to be bought from most of our nursery men.
<i>Lichen Roccella</i>	p. 1622	Argal, Canary-weed, or Or-chell	'Tis possible this valuable plant may be found in our American islands, as well as in the Canaries and Cape-Verd islands.
<i>Cistus Ladanifera</i>	p. 737	Gum Labdanum	In Spain and the Archipelago.
<i>Bubon Galbanum</i>	p. 364	Gum Galbanum	In Ethiopia.
<i>Pastinaca Opoponax</i>	p. 376	Gum Opoponax	In Sicily.
<i>Amomum Cardamomum</i>	p. 2	Cardamums	In the East Indies.
<i>Curcuma Longa</i>	p. 3	Tumerick	In the East-Indies.
<i>Astragalus Tragacantha</i>	p. 1073	Gum Tragacanth or Gum Dragon	In the south of France and in Sicily.
<i>Cucumis Colicynthis</i>	p. 1435	Coloquintida, or Bitter apple	In Africa.
<i>Gentiana lutea</i>	p. 329	Gentian	In the Alps, Apennines, and Pyrenees. To be had of the nursery-men.

Similax

§ The single flowering or fruit-bearing Pomegranate, will afford the most grateful addition to the fruits of our colonies, and a valuable medicine. The ripe fruit full of seeds is to be met with at our fruit-shops in the winter season: from the seeds of such fruit this tree may be easily propagated.

Latin Names.	2d Ed. L. Sp.	English Names.	Observations.
Similax China	p. 1459	China root	In China and in New-Spain.
Pimpinella Anisum	p. 379	Anise seeds	In Ægypt.
Gambogia Gutta	p. 728	Gamboge	In the East-Indies.
Quercus Coccifera	p. 1413	Alkermes oak	About Marfeilles and Toulon.
Myrrha Offic.	Dale. 325	Gum Myrrh	In Abyffinia. The characters of this plant and the five following are not yet known to the botanists.
Benzionum Offic.	Dale. 303	Gum Benjamin	In Sumatra and Java.
Ammoniacum Offic.	Dale. 119	Gum Ammoniacum	In Africa.
Balsamum Peruanum	Dale. 337	Natural Balsam of Peru	In Peru.
Olibanum Thus Masculum	Dale. 348	Frankincense	In the Upper Ægypt and interior parts of Africa.
Nux Moschata Offic.	Dale. 302	Nutmegs with Mace ¶	In Amboyna.
Caryophyllus aromaticus	Lin. Sp. 735	Cloves	In the Molucca islands.
Piper Nigrum	p. 40	Pepper	Sumatra.
Garcinia Monga stona	p. 635	Mangosteens	A most delicious fruit, grows in Java, and in several parts of the East-Indies.

Lechee

¶ Specimens of the Nutmeg-tree in fruit from the island of Tobago have been lately received by the Earl of Hillsborough, which his Lordship has sent, with specimens of many other curious plants, for the information of the public, to the British Museum. They are certainly of the same genus with the true nutmeg, and possibly may be improved by cultivation; the mace evidently covers them, and they have all the characters and the same leaves with the wild Nutmeg tree described by Rumphius, in his Herbarium Amboinense, published by Burman.

Latin Names.	2d Ed. L. Sp.	English Names.	Observations.
Lechee		Lechee of China	This fruit is highly com- mended by all persons who have been in Chi- na .
Ipecacuanha	Dale. 170 Margrave 17	Ipecacuanha of the shops, or Brazilian root	Very useful in medicine, and worthy of our at- tention to propagate it in our West-India islands : at present its genus is unknown to the botanists.
Ferula Assa Fetida	Lin. Sp. 356	Assa Fetida, or Devil's dung, called Hing in the Malay lan- guage	The gum of this plant is much used in medicine. Kämpf. 535 and 536.

To this catalogue may be added liquorice, saffron, and aloes socotorina : of the two first we do not raise near a sufficiency at home for our own consumption, but are obliged to import those articles from Spain.

The Society having thought proper to give a place to the foregoing Catalogue ; it may be necessary to subjoin some DIRECTIONS, (taken also from Mr. Ellis's Pamphlet,) for bringing over Seeds and Plants from distant Countries, in a state of Vegetation.

MANY valuable trees and plants, yet unknown to us, grow in distant countries, particularly in the Northern Provinces of China, about the latitude of 40 degrees, which would thrive well in North-America, more especially in these middle Colonies, which lie about the same latitude. But as the distance is great, the manner of preserving the Seeds properly, so as to keep them in a state of vegetation, is an affair of considerable consequence and some difficulty. The following hints are therefore offered for that purpose.

IN

¶ The characters of this fruit are not yet known to the botanists,

In the first place it ought to be carefully attended to, that the Seeds should be perfectly ripe when they are gathered; and they should be gathered, if possible, in dry weather; afterwards they should be spread thin on paper or matts, in a dry airy room, but not in sunshine. The time necessary for this operation will vary according to the heat of the climate, or season of the year, from a fortnight to a month, or perhaps two may be necessary; the hotter the season, the less time will suffice. This is to carry off their superfluous moisture, which if confined would immediately turn to mouldiness, and end in rottenness.

As there are two methods that have succeeded, and put us in possession of several young plants of the true tea-tree of China, I shall mention them both, in order to assist the collector in bringing home the seeds of many valuable plants.

THE first is by covering them with bees-wax in the manner explained in Phil. Transact. vol. LVIII. p. 75.

It principally consists in choosing only such seeds as are perfectly sound and ripe. To prove this, we must cut open some of them to judge what situation the rest may be in, taking care to lay aside any that are outwardly defective, or marked with the wounds of insects. When a proper choice of them is made, they should be wiped extremely clean, to prevent any dirt or moisture being inclosed; each seed then should be rolled up carefully in a coat of soft bees-wax half an inch thick: the deep yellow English bees-wax is the best. When you have covered the number you intend to inclose, pour some of this bees-wax melted into a chip-box of six or seven inches long, four broad, and three deep, till it is above half full; and just before it begins to harden, while it is yet fluid, put in the Seeds you have rolled up in rows till the box is near full; then pour over them some more wax while it is just fluid, taking care when it is cold to stop all the cracks or chinks that may have proceeded from the shrinking of the wax, with some very soft wax; then put on the cover of the box, and keep it in as cool and airy a place as you can.

THE

THE method of inclosing tea-seeds singly in wax, and bringing them over in that state, has been practised for some time; but few have succeeded, owing to the thinness of the coat of wax, or putting paper first round them, or inclosing them too moist.

To this I must add a method that promises success for bringing over plants from the West-Indies, and the southern parts of North-America, particularly West-Florida, the voyage from hence being longer than from the West-Indies, and more attention is required to keep the plants in health, than from any other parts of our North-American settlements: but as there is a good deal of difference in the climates of these places, it will be necessary to observe, that plants from the West-Indies should be put on board in the latter end of spring, so as to arrive here in warm weather, otherwise they will be destroyed by the cold of this latitude; and the ever-greens, which are the most curious from West-Florida, must be sent in the winter months, while their juices are inactive, so as to arrive here before the heats come on. If the plants sent from these countries were planted in pots or boxes, and kept there a year, they might be brought over with very little hazard; or even if they were first transplanted from the woods into a garden, till they had formed roots, they might be sent with much more safety.

THE size of the boxes that will be most convenient for stowing them on board merchant-ships, where there is very little room to spare, should be three feet long, fifteen inches broad, and from eighteen inches to two feet deep, according to the size of the young trees; but the smallest will be most likely to succeed, provided they are well rooted. There must be a narrow ledge nailed all round the inside of the box, within six inches of the bottom, to fasten laths or packthread to form a kind of lattice-work, by which the plants may be the better secured in their places. If the plants are packed up just before the ship sails, it will be so much the better.

WHEN they are dug up, care must be taken to preserve as much earth as can be about their roots; and if it should fall off,

off, it must be supplied with more earth, so as to form a ball about the roots of each Plant, which must be surrounded with wet moss, and carefully tied about with packthread, to keep the earth about the roots moist : perhaps it may be necessary to inclose the moss with some paper or broad leaves (as the palmetto) that the packthread may bind the moss the closer. Loamy earth will continue moist the longest. There must be three inches deep of wet moss put into the bottom of the box, and the young trees placed in rows upright close to each other, stuffing wet moss in the vacancies between them, and on the surface ; over this palmetto leaves, if to be had, should be put to keep in the moisture, and over them the laths are to be fastened cross and cross to the ledges or packthreads to be laced to and fro, to keep the whole steady and tight. The lid of the box should be either nailed down close, or may have hinges and a padlock to secure it from being opened, as may be found necessary, with proper directions marked on it to keep the lid uppermost. There must be two handles fixed, one at each end, by which means there will be less danger of disturbing the plants. Near the upper part of the ends of the box, there must be several holes bored to give air : or in making the box there may be a narrow vacancy left between the boards of one third of an inch wide, near the top, to let out the foul air ; and perhaps it may be necessary to nail along the upper edge of these openings list, or slips of sail-cloth, to hang over them, to secure the plants from any spray of the sea ; and at the same time it will not prevent the air from passing through. Boxes with plants packed in this manner, must be placed where there is free air, that is, out of the way of the foul air of the ship's hold.

THE following method of preserving seeds from turning rancid from their long confinement, and the great heat of the climates which they must necessarily pass through from China, was communicated to me some years ago by the celebrated Professor Linnæus, of Upsal, in Sweden. He advises, that each sort of Seed should be put up in separate papers, with fine sand among them, to absorb any moisture (dried, loamy, or soapy earth may be tried) : these papers, he says, should be packed close in cylindrical glass, or earthen vessels, and the

M m

mouths

mouths covered over with a bladder, or leather tied fast round the rims: he then directs that these vessels, with the seeds in them, should be put into other vessels, which should be so large, that the inner vessel may be covered on all sides, for the space of two inches, with the following mixture of salts. Half common culinary salt; the other half to consist of two parts of salt-petre, and one part of sal-ammomiac, both reduced to a powder, and all thoroughly mixed together, to be placed about the inner vessel, rather moist than dry. This he calls a refrigeratory; and says it will keep the seeds cool, and hinder putrefaction. Perhaps if small tight boxes, or casks or bottles of seeds were inclosed in casks full of salts, it might be of the same use, provided the salts do not get at the seeds; and as sal-ammoniac may not be easily met with, half common salt, and the other half salt-petre, or common salt alone, might answer the same end. But it would be very necessary to try both methods, to know whether the latter would answer the purpose of the former, as it would be attended with much less trouble, and might prove a useful method to our seedsmen, in sending seeds from hence to those warm climates.

THE smallest seeds being very liable to lose their vegetative power by long voyages through warm climates, it may be worth while to try the following experiment upon such kinds as we know for certain are sound. Dip some square pieces of cotton-cloth in melted wax, and while it is soft and almost cold, strew the surface of each piece over with each sort of small seed, then roll them up tight, and inclose each roll in some soft bees-wax; wrapping up each of them in a piece of paper, with the name of the seed on it; these may be either surrounded as before with salts, or packed without the salts in a box, as is most convenient.

THERE are many seeds, which we receive both from the West Indies and the southern parts of our North-American colonies, as South-Carolina, Georgia, &c. which the gardeners find very difficult to raise here, unless the following method is pursued. Divide a box, according to your quantity and sorts of seeds, into several square petitions; then mix the seeds with loamy earth and cut moss, and put each sort into its separate

parate cell, filling it up to the top: the earth and moss must be rather inclining to dry than wet; then nail the lid down very close on your box, keeping it in an airy situation. If the voyage does not exceed two months, they will arrive in good order in the spring; and, though many of them may begin to germinate, yet, if they are sown directly, they will succeed much better than those that are brought over in papers, as is well known to our most curious gardeners. Seeds of the nutmeg-tree from Tobago, the cinnamon-tree, the cacao or chocolate-nut, and Avocado pear, must be brought in this manner. Seeds of all the sorts of magnolias, stewartias, chionanthus, and many others from South-Carolina, will succeed better this way, than any other method we yet know.

THE seeds of many of the small succulent fruits may be brought to England from very distant parts, by pressing them together, squeezing out their watery juices, and drying them in small cakes gradually, that they may become hard; they may be then wrapt up in white writing paper, not spongy, as this is apt to attract and retain moisture; but I believe it will be found, that a covering of wax will be better than one of paper.

THE Alpine strawberry was first sent to England in a letter from Turin to Henry Baker, Esq; F. R. S. by pressing the pulp with the seeds thin upon paper, and letting it dry before they were inclosed. The paper mulberry from China was brought hither about the year 1754, much in the same manner.

THESE hints may prompt us to try the larger succulent fruits; for instance, the mangoes, lechees, and others of this kind: if their fleshy part, when they are very ripe, was brought to the consistence of raisins or dried figs, it would keep their kernels plump, and in this state they might be better preserved in wax, than by any other method yet known.

*Itasca in Salt
Di Opina inter
Vol. 4. p. 3.*

An Attempt to account for the CHANGE of CLIMATE, which
has been observed in the Middle Colonies in North-America.

By HUGH WILLIAMSON, M. D.

Read before the Society, August 17th, 1770.

IT is generally remarked by people who have resided long
in Pennsylvania and the neighbouring Colonies, that with-
in the last forty or fifty years there has been a very observable
Change of Climate, that our winters are not so intensely cold,
nor our summers so disagreeably warm as they have been.

THAT we may be enabled to account for these phenomena
it will be necessary to take a transient view of the general cause
of winds, and the remarkable difference of heat and cold, that
is observed in different countries under the same parallels.

THO' the Sun is doubtless the general source of heat, yet we
observe that countries are not heated in proportion to their
distance from the Sun, nor even in proportion to their distance
from the Equator. The inhabitants of the Polar Circles are
hardly a perceivable distance, not a twenty-thousandth part
farther from the Sun, than those between the Tropics, and
yet the former are chilled with perpetual cold, while the others
are scorched with constant heat.

WHEN the rays of the Sun strike the Earth in a perpendi-
cular direction, they will be reflected in the same direction on
the particles of air through which they have passed, and thus
increase their heat; a greater number of direct rays will also
strike the Earth in any given space, than when they fall
obliquely; therefore, the nearer the direction of the Sun's rays
is to a perpendicular with the surface of the Earth, the great-
er ceteris paribus will the heat be. Hence, countries should
be colder the nearer they are to the Poles. But,

WE observe that the air may be heated to a very different
degree in different countries, which are in the same latitude,
according

according as they abound in rough mountains, fertile plains, or sandy deserts; as they are surrounded by land or by sea, or according to the different wind, which prevail in those countries. The temperature of Pennsylvania is very different from that of Portugal; and the temperature of England is different from that of Saxony, on the neighbouring continent, though they be under the same parallels. In order then that we may be enabled to form an estimate of the heat of any country, we must not only consider the latitude of the place, but also the face and situation of the country, and the winds which generally prevail there, if any of these should alter, the climate must also be changed. The face of a country may be altered by cultivation, and a transient view of the general cause of winds will convince us, that their course may also be changed.

It is generally believed that most winds are occasioned by the heat of the Sun. Were the Sun to stand still over any particular part of the surface of the earth, the wind would constantly blow to that place from all directions. For the air in that part being rarified by the heat of the Sun, would be expanded and thus become lighter, whence it would ascend, and the heavier air in the neighbouring parts would rush in, to occupy its place; this too being heated both by the Sun's rays and by the warm surface of the Earth, would instantly ascend to give place to that which was colder. But as the Sun moves, or seems to move, between the Tropics, from East to West, there should be a constant current of air setting towards the Sun from the North, South, and Eastward, while the current, which would also come from the West, is prevented or turned back by the Sun, who moves with great rapidity on the opposite direction. The current coming from the North and South, falls in with that from the Eastward, and is presently bent in the same direction. This constitutes what seamen call a *Trade Wind*; such is found in the Atlantic, and in the Great South Sea.

WERE the surface of the Earth homogeneous, were it all covered with water, or all smooth dry land, the easterly winds would always prevail quite round the Globe to some distance beyond the Tropics. But the waters along the Equator are divided.

divided by two or three considerable portions of land, which retain the heat in a different manner from the water, and reflect the Sun's rays in very different proportions, so that they not only stop the easterly current of air, but often change it to the opposite direction. For along the westerly coast of Africa, and South-America, the winds commonly blow from the West. That is to say, they blow from a cold surface to that which is warmer, they blow from the sea in upon the land. For,

In warm countries, or in the warm season of any country, the surface of the land is warmer than the surface of the water.

In cold seasons of temperate countries, the surface of the land is colder than the surface of the water.

THE surface of the Earth being immovably exposed to the Sun, receives and retains the heat, and grows warmer by every adventitious ray; so that a hard smooth surface will sometimes become intolerable to the touch, but the heat does not sink deep, except in a considerable progress of time.

THE surface of the Sea is not soon heated, for the particles which are uppermost this hour, will presently be overwhelmed by those which are colder, and they, by others in succession; whence it happens, that though the surface of the Sea will not become so warm by a summer's heat as the surface of the Earth, in the same climate, yet the heat will penetrate deeper, and be longer retained.

LET us transfer these trite and general reasonings to the situation of our Middle Colonies, with respect to Land and Water. Our coast runs nearly from North-East to the South-West, so that if the land should at any time be colder than the sea, and a current of cold air should set towards the sea, it must pass from the North-West to the South-East: But such winds we find generally take place during our winter season. For the Atlantic, to the South-Eastward, is greatly heated during the summer season, and will not soon lose that heat when the Sun goes to the Southward in the winter; add to this,

this, a very notable circumstance, which is, that our coast is constantly washed by a current of warm water, which being driven to the West by the easterly trade winds near the Equator, is checked in the Gulph of Mexico, and obliged to escape to the North-Eastward, to give place to the succeeding current. But the surface of these colonies soon grows cold in the absence of the Sun. Hence violent torrents of winds pass towards the Atlantic during the winter season; the colder the air is over the continent, the more violent will those North-Westers be.

CAN we discover any change of circumstances, which might reduce the violence of those North-Westers, or remove them entirely? It is very obvious that hard smooth surfaces reflect heat better than those which are rough and unequal; the surface of a looking-glass, or any polished metal, will reflect more light and heat, than the rough surface of a board. In the same manner we observe, that rocks and smooth beds of sand reflect more heat, than a soft broken surface of clay. A clear smooth field also reflects more heat, than the same space would have done, when it was covered with bushes and trees.

If the surface of this continent were so clear and smooth, that it would reflect so much heat as might warm the incumbent atmosphere, equal to the degree of heat produced by the neighbouring Atlantic, an equilibrium would be restored, and we should have no stated North-West Winds: But we have already made considerable approaches to this very period, several Members of the Society must have observed, that our North-West Winds, during the winter season, are less frequent, less violent, and of shorter continuance, than formerly they were. Seamen, who are deeply interested in this subject inform us, that in the winter season they have been beating off our coast three, four, or five weeks, not able to put in, by reason of the North-Westers; they are now seldom kept off twice that number of days. It is also agreed, that the hardness of our frosts, the quantity and continuance of our snows, are very unequal now, to what they have been, since the settlement of this Province.

It is

It has been objected, that the small alteration which the surface of a country undergoes in being cleared and cultivated, is not equal to producing such considerable changes of climate, as has been observed to take place in many parts of the world. I shall not say, that a change of climate may not arise from other causes than the one I have described. It is very certain, that the simple solution of water in air will produce cold, which may be increased by a solution of nitrous salt. There are sundry other causes, from which the heat of the air may be increased or diminished, yet I cannot recollect a single instance of any remarkable change of climate, which may not be fairly deduced from the sole cultivation of the country. The change which has happened in Italy, and some countries to the eastward, within the last seventeen Centuries, is thought to be a strong objection to this general rule. It is said, "that Italy was better cultivated in the Augustine age than it is now; but the climate is much more temperate now than it was at that time. This seems to contradict the opinion, *that the cultivation of a country will render the air more temperate.*"

I SHALL consider this observation the more attentively, because I find it has been made by an ingenious Writer, of great Classical Erudition *.

It is not to be dissembled that their winters in Italy were extremely cold about seventeen hundred years ago. Virgil has carefully described the manner in which cattle are to be sheltered in the winter, lest they should be destroyed by the frost and snow; he also speaks of wine being frozen in the casks, and several other proofs of such extreme cold, as would surprize us in this Province. Though it is also clear, that the Italians are now as great strangers to cold and frost, as those of Georgia or South-Carolina. To account for this remarkable change, we must go beyond the narrow limits of Italy; we must traverse the face of Hungary, Poland and Germany, those vast regions to the northward of Rome. The Germans have certainly made immense progress in population and agriculture, since Julius Cæsar with a few legions overran that country; for notwithstanding the elegance with which Cæsar describes his victories, he certainly had to contend with a
 felt

* See Philosophical Transaction, vol. 58.

sett of barbarians and savages, whose country was rude and uncultivated as their minds. The general face of those kingdoms was covered with wild extensive forrests, a few of which remain to this day. The small scattered tribes who occupied them, had done very little towards the perfection of agriculture. From these uncultivated desarts piercing North-Winds used to descend in torrents on the shivering Italian, though his own little common wealth were finely cultivated. No person need be informed how numerous the Nations are, who now inhabit Hungary, Poland, and Germany, or how generally those regions are now cultivated, even to the very edge of the Baltic and German Ocean, so that if the cold is greatly moderated in Germany, and the adjacent Northern States, which I believe is generally allowed, we may easily perceive how it should be moderated to a much greater degree in Italy, which being in a low latitude was only annoyed by the cold winds from the Northern Kingdoms. For the air was at that time so cold over those uncultivated regions, that it could effectually destroy the balance in the warmer atmosphere of Italy, which at present is not the case.

As we might have conjectured from established principles of Philosophy, that clearing and smoothing the face of a country, would promote the heat of the atmosphere, and in many cases would prevent or mitigate those winter blasts, which are the general origin of cold, whence the winters must become more temperate, and as facts appear to support and confirm our reasoning on this subject, we may rationally conclude, that in a series of years, when the virtuous industry of posterity shall have cultivated the interior part of this country, we shall seldom be visited by frosts or snows, but may enjoy such a temperature in the midst of winter, as shall hardly destroy the most tender plants.

PERHAPS it may be apprehended, that as clearing the country, will mitigate the cold of our winters, it will also increase the heat of our summers; but I apprehend, that on a careful attention to this subject we shall find, that the same cause will in those seasons appear to produce different effects, and that instead of more heat, we shall presently have less in summer than usual.

It is well known, that during the greatest summer heats of this or any other country, the extraordinary heat of the Atmosphere does not rise to any considerable height. In the upper regions it is perpetually cold, both because the air in those parts is too far from the Earth, to be warmed by the heat of its surface, and because the air in those regions not being pressed by such a weight of incumbent Atmosphere is too rare to be susceptible of a great degree of heat; for the heat of the air, as of every other body, that is warmed by the Sun, depends not only upon the simple action of the particles of light upon those of the air, but also upon the mutual action of the particles of air upon one another, which, by their elasticity, propagate or continue that motion, called heat, which was originally excited by the Sun's rays. Therefore, the rarer the Atmosphere is, the less heat will be produced therein by the Sun, & vice versa. Hence we observe, that in the warmest countries the tops of mountains are always covered with snow. Whoever will carry a Thermometer on a very warm day to the top of an high steeple, will find that the Mercury immediately falls several degrees, and rises again as he descends. From this it is obvious that nothing is wanting in the midst of summer to render the country agreeably cool, but a proper mixture of the cold air which is above, with the warm air below. This would be effected by any cause that might increase our summer winds. For though the simple motion of the air does not by any means produce cold, yet, moderate blasts will naturally introduce a colder Atmosphere, especially when they pass over hills or any unequal surface, by which the equilibrium of the Atmosphere is destroyed, the cold air always tending towards the surface. Hence a summer's gust is generally attended by a sudden change in the temperature of the air. Tall timber greatly impedes the circulation of the air, for it retards the motion of that part which is near the surface, and which, from its density and situation being most heated, becomes the general origin of such agitations as take place in the upper regions. We shall often find it extremely sultry and warm in a small field, surrounded by tall woods, when no such inconveniency is perceived on an extensive clear plain in the neighbourhood. From these particulars we may conclude, that when this country shall be diversified, as it must be in a series.

series of years, by vast tracts of clear land, intersected here and there by great ridges of uncultivated mountains, a much greater degree of heat being reflected by the plains than from the neighbouring mountains, and an easy circulation of air produced on the plains. Our land winds in summer, to say nothing of those which come from the sea, or from the lakes, must certainly be much fresher and more frequent than they now are, and consequently our summer heats be more temperate.

A CONSIDERABLE change in the the temperature of our seasons may doubtless effect a change in the produce of our lands. Temperate seasons must be friendly to meadows and pasturage, provided we continue to get regular supplies of rain; but of this, there is some reason to doubt, unless our mountains, with which this country happily abounds, should befriend us greatly. The decrease of our frosts and snows in winter, must for many years prove injurious to our wheat and winter's grain. The vicissitudes of freezing and thawing have already become so frequent, that it is high time for the farmer to provide some remedy, whereby he may prevent his wheat from being thrown out in the winter season.

A CONSIDERABLE change in the temperature of our seasons, may one day oblige the Tobacco Planter to migrate towards the Carolinas and Florida, which will be the natural retreat of that Plant, when the seasons admonish the Virginian to cultivate wheat and Indian corn. The tender Vine, which would now be destroyed by our winter's frost, in a few years shall supply the North-American with every species of wine. Posterity will doubtless transplant the several odoriferous, aromatic, and medicinal plants of the eastern countries, which must flourish in one or another part of North-America, where they will find a climate and soil favourable to their growth, as that of their native country.

EVERY friend to humanity must rejoice more in the pleasing prospect of the advantages we may gain in point of Health, from the cultivation of this country, than from all the additional luxuries we may enjoy, though both the Indies were

brought to our doors. The salutary effects which have resulted from cleansing and paving the streets of Philadelphia, are obvious to every inhabitant. For causes somewhat similar to these, the general improvement of the colonies have already produced very desirable effects. While the face of this country was clad with woods, and every valley afforded a swamp or stagnant marsh, by a copious perspiration through the leaves of trees or plants, and a general exhalation from the surface of ponds and marshes, the air was constantly charged with a gross putrescent fluid. Hence a series of irregular, nervous, bilious, remitting and intermitting fevers, which for many years have maintained a fatal reign through many parts of this country, but are now evidently on the decline. Pleuritic and other inflammatory fevers, with the several diseases of cold seasons, are also observed to remit their violence, as our winters grow more temperate.

SINCE the cultivation of the colonies, and the consequent change of climate, has such effects on the diseases of the human body, and must continue to produce such remarkable changes in their appearance, it is certainly the duty of every Physician, to be careful to trace the history of every disease, observe the several changes they undergo, and mark, with a jealous attention, the rise of every new disease, which may appear on the decline of others, that so he may be enabled to bring effectual and seasonable relief to such persons, as may be committed to his care.

TRANSACTIONS
OF THE

American PHILOSOPHICAL SOCIETY.

SECT. III.

MISCELLANEOUS PAPERS.

An Account of the Eruption of VESUVIUS, in 1767, communicated in a Letter from an English Gentleman residing at Naples, to JOHN MORGAN, M. D. F. R. S. and Professor of Medicine, in the College of Philadelphia.

Naples, November 3, 1767.

S I R,

WE have had a most extraordinary eruption of Vesuvius lately. As I imagine an account of the disturbance it has given us will not be disagreeable to you, I shall therefore do myself the pleasure of communicating to you what I know, and have seen myself, of this surprizing Phænomenon.

THE beginning of it is exactly described in Pliny the younger's letter to Tacitus*. The first alarm was taken from

* As it may give the curious reader pleasure to compare the above description with the more striking passages of Pliny the younger's letter, on the same subject, we have here subjoined them.

" Nubes,

from a column of black smoke, thrown out with such violence as to appear like an immense pine, branching out on all sides after a great height of trunk, when the diminution of the force, that threw it out, allowed the air to operate by spreading it. The whole mountain was soon wrapped round with utter darkness; and its place was only to be distinguished by the many streams of fire that were darted in different directions, and made this darkness visible.

It appeared to me very unaccountable at first, but I afterwards found, by the assistance of my glasses, that these different directions were produced by the particular motion impressed upon the fire, as it issued from the several mouths which gave vent to Vesuvius. It was very extraordinary to observe some of these streams descending perpendicularly, whilst others mounted upwards in a strait line. The former appearance was owing to innumerable ignited stones in their fall, after having been thrown from some superior aperture, that acquired such velocity from their weight, and such a blending of light from their proximity, as to seem one impetuous torrent of fire; though on the usual appearance of these falling stones, they are scattered, and are plainly to be distinguished as separate bodies.

ALL this, as a mere object of sight, would rather have been amusing; but a frequency of the most terrible explosions made it very alarming, especially to me, in a house that shakes with the least motion. The noise of the largest cannon fired from the castle, not three hundred yards from me, is a mere whisper to these explosions. My little household had retreated to the rooms backward, built against the hill, and

"Nubes, incertum procul intuentibus ex quo monte, Vesuvium fuisse postea cognitum est, oriebatur: cujus similitudinem & formam non alia magis arbor, quam Pinus expresserit. Nam longissimo velut trunco efflata in altum, quibusdam ramis diffundebatur. Credo quia recenti spiritu eversa, dein senescente eo destituta, aut etiam pondere suo victa, in latitudinem vanescebat, candida interdum, interdum sordida & maculosa, prout terram cineremve sustulerat." *Plinii Epistol. xvi. lib. vi.*

"Interim e Vesuvio monte pluribus locis latissime flammæ atque incendia relucebant, quorum fulgor & claritas tenebras noctis excipiebat.

"Jam dies alibi, illic nox omnibus noctibus nigrior densiorque, quam tamen faces multæ variaque lumina solvebant." *Ibidem.*

"Ab altero latefe nubes atra & horrenda ignei spiritus tortis vibratisque discursibus rupta, in longas flammarum figuras dehiscebat, fulgoribus illæ & similes, & majores erant." *Plinii Epistol. xi. lib. vi.*

and I made most of my observations in the door-way of my newest and thickest wall. One or two, however, the most severe of these shocks, that raised my man, who 'till then had kept by me, from the ground, caused me to hesitate, and think of making a prudent retreat ||; but it occurred to me on a little reflection, that the streets might have been equally dangerous from mixing with a tumultuous concourse of people, thronging after the pictures of Madona and of the saints carried in procession, with which the whole city was crouded all night: I thought it most prudent, therefore, to keep out of their way. The shocks afterwards abated, or I was more used to them, and a most comfortable † lava made its sally, from a seeming opening of the whole side of the mountain at once, and rushed forward with an impetuosity that, in two hours, brought it within two miles of Portici †, which quieted me for that night. The King was then at his palace there, which Vesuvius seemed to be reclaiming from his Majesty's encroachments. The place was by no means held tenable against him; and the King, the courtiers, and numbers of families, then in these environs at their Villeggiatura §, were put to the rout at midnight: Some of the court thought themselves not secure even when they reached Naples, and, I am told, continued their flight to Caserta*.

THE next day all was quieted by a profuse lava that has filled up the hollow way between the Hermit's ¶ and Vesuvius, of at least an hundred feet in depth.

THE

|| "In commune consultant, intra tectane subsistant, an in aperto vagentur; nam crebris vastisque tremoribus tecta nutabant, & quasi emota sedibus suis, nunc huc, nunc illuc abire aut referri videbantur." *Plinii Epistol. xx. lib. vi.*

† The melted fiery matter thrown out by *Vesuvius*, which grows hard as it cools, and appears to be a semi-vitrified substance. It is here called comfortable, because the mountain generally becomes more quiet upon its being cast out.

† *Portici*; a small town on the bay of Naples, at about six miles distance from that city, built on the ruins of, or rather directly over, the ancient *Herculaneum*. His Sicilian Majesty has a palace here, furnished with many curiosities, found in *Herculaneum*, and frequently keeps his court at *Portici*.

§ This is an Italian word, which signifies the being in the country, or the time of being in the country to take one's pleasure.

* A town twelve miles from Naples, on the contrary side from *Vesuvius*, where the King sometimes holds his court.

¶ In the solitary place, about half way up Mount *Vesuvius*, is an hermitage, where those whose curiosity leads them to examine this wonderful Phenomenon generally call, and are provided with refreshments by the hermit.

THE second night, however, was as turbulent at the mountain, but not so alarming at Naples as the first, because the mountain burst sooner, and on the other side of it, from whence a lava equally copious was delivered, and after fewer throes.

THE third day the agitation of the earth and air was very inconsiderable; but an immense quantity of cinders and ashes filled the whole atmosphere ||, so as to take our bright Sun from us, and to leave us no more of him than we have in London, when thousands of less alarming volcanoes from good kitchens, render the air, in winter, often impervious to any but his strongest rays; and he appeared all-day of the sanguineous colour in which Pliny describes him*.

THE fourth day we had for three hours, or more, one continual thunder, without the terrible explosions however of the first and second nights; and I took great comfort to myself on seeing the constant course of cinders and ashes thrown up. For, I looked upon it as the effect, if I may use the figure, of a bellows blown by all the winds, that would soon destroy or separate the combustible enemy: Accordingly these ashes were the only inconvenience that remained.

BUT on Sunday, the seventh day, the quantity of ashes that filled the air was so great, that having rode out to take a nearer view of the volcano, I was obliged to gallop home with my eyes shut, as I could no longer open them from the pain these ashes put me to †.

ALL is now quiet, and the Lava on this side is stopped, after laying waste the largest tract of cultivated ground that it has

|| "Jam navibus cinis inciderat: quo proprius accederet calidior & densior: jam pumices etiam, nigrique & ambusti & fracti igne lapides: jam vadum subitum, ruinaeque montis littora obstantia."

* "Tandem illa caligo tenuata quasi in fumum, nebulamve decessit: mox dies vespere, sol etiam effulsit, luridum tamen, qualis esse, cum deficit, solet. Occurabant trepidantibus adhuc oculis mutata omnia, altoque cinere, tanquam nive, obducta."

- in *Epistol. xx. lib. vi.*

† "Paullum reluxit, quod non dies nobis, sed ventantis ignis indicium videbatur, ignis quidem longius substitit: tenebrae rursus, cinis rursus multus & gravis: hunc entidem assurgentes excutiebamur, operiti alioqui, atque etiam obliti pondere effus." *Plinii Epistol. xx. lib. vi.*

has destroyed at once within this century. The greatest eruptions of it have been in the year 1707, in the year 1737, and this of 1767. I leave your deep naturalists to account for this periodical crisis; and it may not be the first meer accidental observation that has given birth to a profound system §.

O o

§ Some of the most remarkable eruptions of Vesuvius have happened as follow.

Anno Dom. 76 Mount Vesuvius cast forth such quantities of smoke and flame as to obscure the day, and destroyed the cities of Pompeium and Herculaneum.

In the year 80, on the 23d of August, the elder Pliny, in order to be better acquainted with the cause of the extraordinary eruption of Vesuvius, ventured so near that this great naturalist perished in his enquiry.

Anno 472, Vesuvius ejected flames, in such abundance, that they were seen even at Constantinople; they obscured the sun at noon day, and the fire ravaged and burnt all Campania.

Anno 1007, Vesuvius vomited out so great a quantity of flames, that all the neighbouring country suffered greatly by them.

In the year 1631, Vesuvius threw out flames, in such abundance that upwards of 4000 persons lost their lives, and a large tract of land was destroyed.

In the year 1717, Doctor Berkeley, afterwards bishop of Cloyne in Ireland, visited Vesuvius, at least with as much boldness and curiosity as Pliny the Elder. The account given, by the bishop, of that mountain, was communicated to the Royal Society by Dr. Arbuthnot, and is published in the Philosophical Transactions. It is thus described by the bishop. "The other mouth was lower in the side of the same new formed hill: I could discern it to be filled with red hot liquid matter, like that in the furnace of a glass house, which raged and wrought as the waves of the sea, causing a short abrupt noise, like what may be imagined to proceed from a sea of quick-silver dashing among uneven rocks. This stuff would sometimes spew over, and run down the convex side of the conical hill, and appeared at first red hot; it changed colour and hardened as it cooled, shewing the first rudiments of an eruption, or, if I may so say, an eruption in miniature."

The conflagration in 1731 was so destructive, that it occasioned the following curious inscription, which is placed about three miles distant from Naples, in the road to Vesuvius.

Posteri, posteri, vestra res agitur.

Dies facem præfert diei; nudius perendino.

Advortite.

Vicies ab fatu solis, nifabulator historia, arsit Vesuvius.

Immani semper clade hæsitantium:

Ne posthac incertos occupet, moneo.

Uterum gerit mons hic bitumine, alumine, ferro,

Auro, argento, nitro, aquarum fontibus, gravem.

Serius, ocius ignescit, pelagoque influente pariet:

Sed ante parturit, concutitur, concutit solum,

Fumigat, corruscat, flammigerat, quatit

Aerem, horrendum immugit, boat, tonat,

Arcet finibus accolas.

Emigra dum licit,

Jam Jam enititur, erumpit, mixtum igne

Lacum evomit, præcipiti ruit ille lapsu.

Seramque fugam prævertit.

Si corripit, actum est, periisti.

Anno Salutis 1631,

Tu, si sapias, audi clamantem lapidem.

Spence

A description of a SELF-MOVING or SENTINEL REGISTER, invented by WILLIAM HENRY, of Lancaster.

THE machine consists of the following parts.

1. *A*, A DOOR or common-register, applied in the flue of a furnace. The door is fitted in a frame, and made to slide easily up and down. Plate VI. Fig. I.

2. *B*, A BALANCE or beam, moving on a center; the two arms are of unequal lengths, the longer exceeding the shorter in the proportion of two to one; the extremity of each arm is formed into a segment of a circle, whose radius is equal in length to each respective arm. These segments must be equal to the greatest rise or fall of each end of the balance when in use.

THE length of the whole beam or balance must be regulated by the situation of the register *A*, and the copper *C*, hereafter mentioned.

3. *C*,

Sperne larem, sperne farcinulas;
Mora nulla, fuge.

In E N G L I S H. *this*:
Posterity, posterity, this is your concern,
One day enlightens the next, that next
improves the third.
Be attentive.

Twenty times, since the creation of the Sun,
has Vesuvius blazed, never without a horrid
destruction of those, that hesitated to fly.
This is a warning, that it may never
seize you unapprized.

The womb of this mountain is pregnant with
bitumen, alum, iron, gold, silver, nitre
and fountains of water.

Sooner or later it kindles, and, when the sea
rushes in, will give its birth vent.

But, before its labours come on, it is shaken,
and shakes the earth round it; smokes, gleams,
throws up bickering flames, shakes the air,
roars horridly, bellows, thunders, drives the
inhabitants from its quarters.

Retire whilst you may;
Now, now, its throes come on, it bursts out,
it flings up lakes mixt with fire;

Down, down it rushes and precipitate
Prevents your tardy flight, and stamps your fate:

If it once surprizes you, all is over.
If you are wise, hear this speaking stone.

Neglect your domestic concerns, neglect your
goods and chattels, there is no delaying;
Fly.

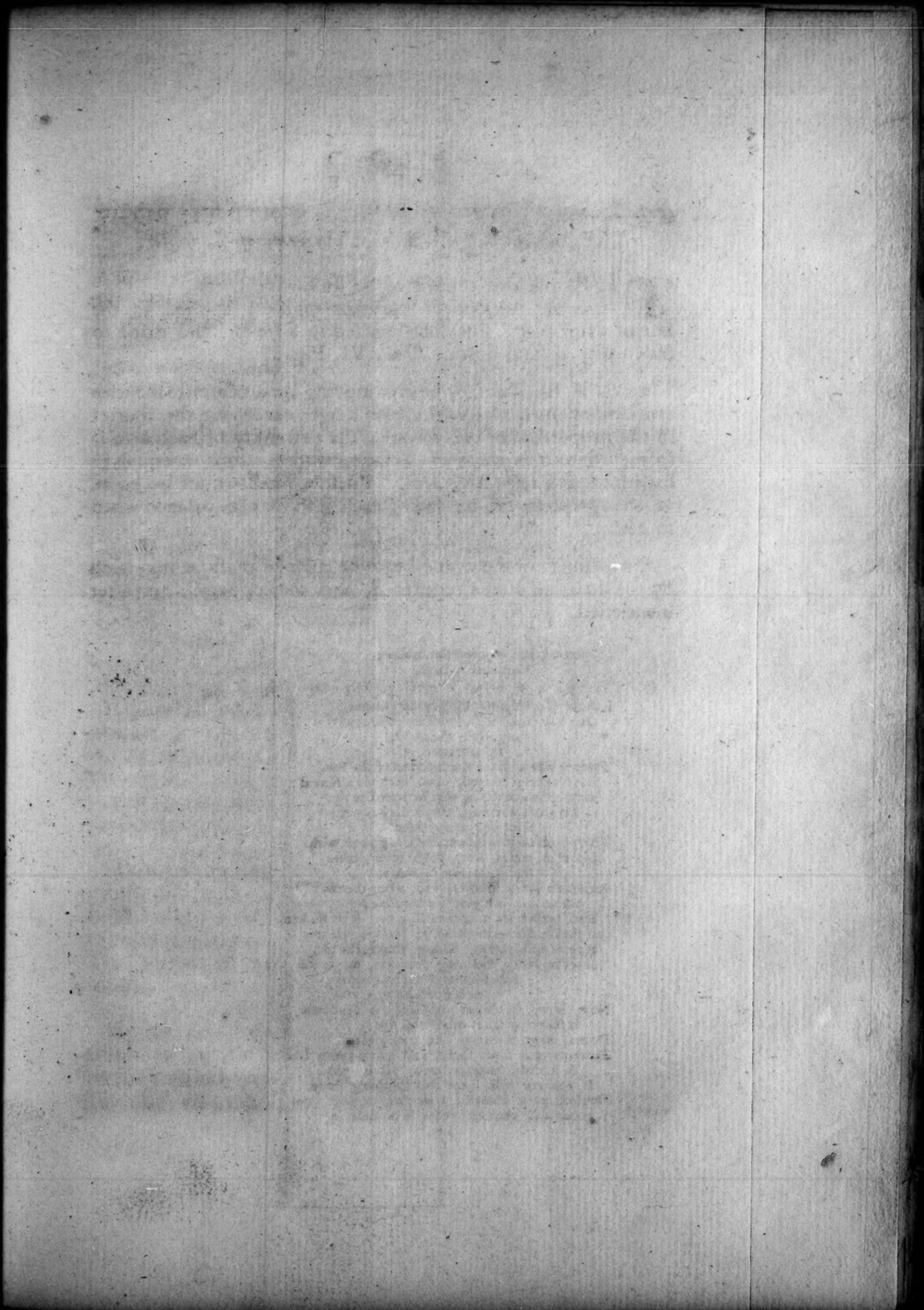


PLATE 6

Fig 1

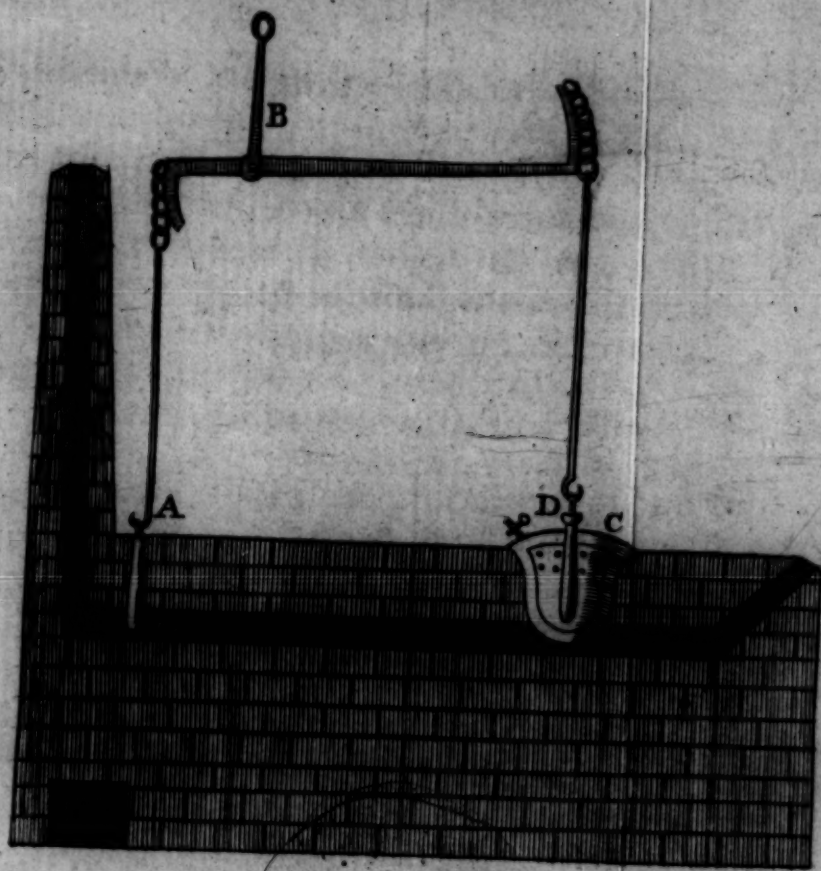
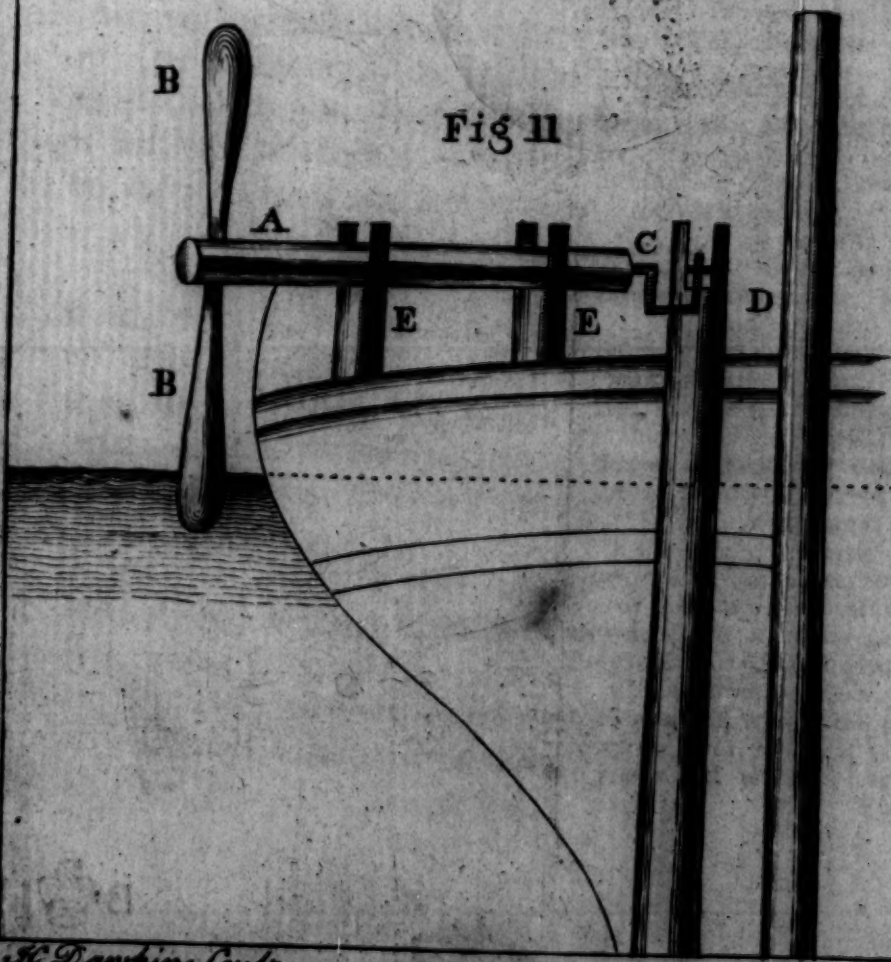


Fig II



H. Danthine Soult.

3. C, A COPPER vessel, about 13 inches diameter, and 10 inches deep, with a double bottom and sides, which are placed about an inch and a half apart from each other, leaving a space between to contain air. The top or cover is brazed on, and the whole made air-tight. Through the top is inserted a brass cock, and also a brass or copper cylinder, open at both ends, about two inches and a quarter in diameter, and two feet long, so fixed as to rise fourteen inches above the top, and to reach near to the bottom of the vessel.

THROUGH the side of the innermost vessel, near the top, are some holes made, whereby the air in the cavity between the two bottoms and sides may communicate with the air in the inside of the vessel.

4. D, A PHIAL two inches diameter, and seven inches deep, corked and sealed, with a hook fixed in the cork, by which the phial is suspended.

THESE are the principal parts of the machine, which are to be applied as follows.

FROM the surface let there be an horizontal flue, of a convenient length. In the walls of the flue, the frame, in which the register slides, is fixed perpendicularly, so that when the register is down, the flue is closed, when the register is drawn up, the flue is opened, and the higher it is raised, the more is the passage of the fire enlarged.

TO the shorter end of the balance, which is supported on a proper fulcrum, at a convenient height, the register is suspended by a chain and a rod; the chain is just long enough to wind over the segment of the circle, at the end of the beam. The register is made so heavy, as to descend by its own weight.

AT the distance of two, three, or more feet from the register, and on the flue of the surface, the copper vessel C is fixed, so as to receive a heat from the fire passing through the flue. The end of the longest arm of the balance extends directly

fectly over the cylinder fixed in the copper, and to it the phial *D* is suspended, so as to hang within the tube, and by such a length of chain and rod as will allow it to be about two or three inches immersed in the tube, when the balance is in equilibrio. On the same end of the beam on which the phial is suspended, a weight is hung sufficient, with the weight of the phial, to over-balance the register, and raise it, and consequently open the flue. When the flue is opened to a due degree, the register is held in that situation, until so much water is poured into the copper through the cock, as will fill one third of the vessel; then shut the cock, and pour water into the cylinder, until it rises high enough to float the phial. By pouring water into the cylinder, the air in the vessel is compressed, and finding no way to escape, as the vessel is air-tight, it resists the water, and prevents its occupying the whole space; and therefore the upper part of the vessel is apparently empty. The phial is loaded with shot, so that it will swim about one third above the water. When the water rises in the tube, the phial rises with it, in which case the register *A* is so balanced, that it descends, and closes the flue.

AFTER this description, the principles on which the Sentinel Register acts, must be obvious to every person acquainted with the elasticity of the air, and that this elasticity is increased by heat. For when the fire in the furnace is increased, the degree of heat in the flue is also increased; this increases the elasticity of the air contained between the double bottom and sides of the copper, and consequently of that, which occupies the space above the water, as there is a communication by means of the holes already described. The elasticity of the air being increased it expands, and by its expansion forces the water up the tube; the water being raised, carries the phial with it, whereupon the register preponderating descends, closes the flue, and by lessening the draught of the chimney or flue, deadens or checks the fire in the furnace. By this means again the heat in the flue is diminished, the air in the cavity becomes cooler, and consequently less elastic, whereupon the water descends in the tube, and with it the phial to its stationary point. By the descent of the phial the register is raised, and opens the flue; by which means it stands as a Sentinel over the fire, and preserves an equal degree of heat.

THAT

THAT this will be the effect of the machine, I can attest, having used it for more than a year.

It is submitted to the curious, whether this machine might not be usefully applied, 1st, to regulate the heat of chymical and alchymical furnaces, where long digestions, and a uniform degree of heat are required; 2dly, in the making of steel, and in burning of Porcelain ware, in which a due regulation of the fire is of great importance; 3dly, in green or hot houses, and in apartments for hatching chickens, according to the Egyptian method. With a little alteration it might be applied to the purpose of opening doors, windows, and other passages, for a draught of air, and thereby preserve a due temperature of the air in hospitals, &c.

*An Account of a MACHINE for pumping Vessels at Sea,
without the Labour of Men.*

By RICHARD WELLS.

IN the course of the immense trade now pursued on the ocean, vessels are continually subject to leaks, which too often prove fatal to the crews, who, wearied out with incessant pumping, are obliged, at last, to submit to their unhappy fate, and desponding sink into their watery graves. It is therefore much to be desired, that some method could be suggested for preserving the lives of so intrepid and useful a set of men. What has occurred to me on this subject, I beg leave to lay before the Society, and flatter myself, it will not prove altogether unworthy of notice.

WHEN a vessel springs a leak at sea, which cannot be discovered, instead of exhausting the crew with continual working at the pumps, they may form, with very little trouble, a machine to discharge the water, which will work itself, without any assistance from the hands on board.

LET a spar or spare top-mast be cut to the length of eight or ten feet, or more, according to the size of the vessel; mortice
four

four holes through the thickest end, through which run four oars, fixing them tight, exactly in the middle; to the four handles of the oars nail on four blades (made of staves) the size of the other ends, which will form a very good water wheel, if the oars are strong; then fix into the opposite end, what is commonly called a crank; the iron handle of a grindstone would suit extremely well; if not to be had, any strong bar of iron may be bent into that form, wedging it tight, to prevent its twisting round: then nail up a new pair of chaps on the fore part of the pump, for a new handle to be fixed in, which will point with its outer end to the bow of the vessel; this handle will be short on the outside, but as long on the inside as the diameter of the bore of the pump will admit, in order that the spear may be plunged the deeper, and of course make the longer stroke; the handle must be large enough to have a slit sawed up it, sufficient to admit a stave edge ways, which must be fastened with a strong or iron pin, on which it may work; the lower end of the stave must be bored, to admit the round end of the crank; then fix the shaft with the oars (or arms) over the gunwale on two crotches, one spiked to the gunwale, and the other near the pump, cutting in the shaft a circular notch, as well to make it run easier, by lessening the friction, as to keep the whole steady. A bolt must be fixed in each crotch, close over the shaft, to keep it from rising; as soon as the wheel touches the water, it will turn round, and the crank, by means of the stave fixed on its end, will work the handle of the pump. If the bore be four inches, and the piston or spear moves eighteen inches at a stroke, it will discharge 220 cubic inches of water, and admitting the arms of a wheel to be six feet from the center, it will turn round about 146 times in a mile, or 730 times in an hour, when the ship sails five knots, which is equal to nine hogsheads. If the surface of the water in the whole be fifteen feet from the nozzle of the pump, a man can raise in an hour, with common working, about thirty-eight hogsheads, which far exceeds the work performed by the wheel; but this calculation is made on pumps of the common size, I would therefore propose that all vessels should carry larger pumps, the advantage of which will appear from the following table.

A 4 inch bore will discharge per hour, sailing at the rate of	
five knots,	9 hogheads
5 inch,	14 and an half.
6 ditto,	20 and 3-4ths.
7 ditto,	28 and 1-4th.
8 ditto,	37 hogheads.

HENCE we find, that a pump of eight inches bore, will discharge with the wheel nearly the same quantity that a man commonly raises. If both pumps be set to work by the crank, double the quantity, or 74 hogheads will be discharged; but if a cog wheel, of about three feet ten inches, with 51 cogs, be fixed on the end of the shaft or axis, and the crank be passed through a trundle or lanthorn wheel, of about two feet diameter, with thirteen rounds, to work with the axis parallel to the deck, and fixed to the pumps, in the manner used by brewers and distillers, the crank will make about four turns to one revolution of the great wheel, and of course deliver 296 hogheads per hour; yet as the resistance made by the pumps will, in some measure, impede the motion of the wheel, it will not turn at the rate of 730 times in an hour, for which suppose a deduction of one-third, which is certainly a great allowance, the quantity then discharged per hour is about 200 hogheads, which is more than equal to the constant work of five men; thus if a vessel sailing at the rate of

5 Knots,	delivers 200 hogheads per hour,	equal to five mens work.
6 Knots is	240	equal to 6 ditto.
7 Knots	280	equal to 7 ditto.
8 Knots	320	equal to 8 mens work.

I AM aware of many objections that will be suggested. In the first place it will be said, that pumps of eight inches bore, will be too large to be worked by the strength of men, when the wheel cannot be applied. I answer, no more force is required to discharge a gallon of water at a stroke from an eight inch, than from a four inch bore; as the short end of the lever or handle to the eight inch bore, need not be above a quarter part the length of the four inch, which will give a purchase to the sailor at the long end of the lever, sufficient to raise the piston.

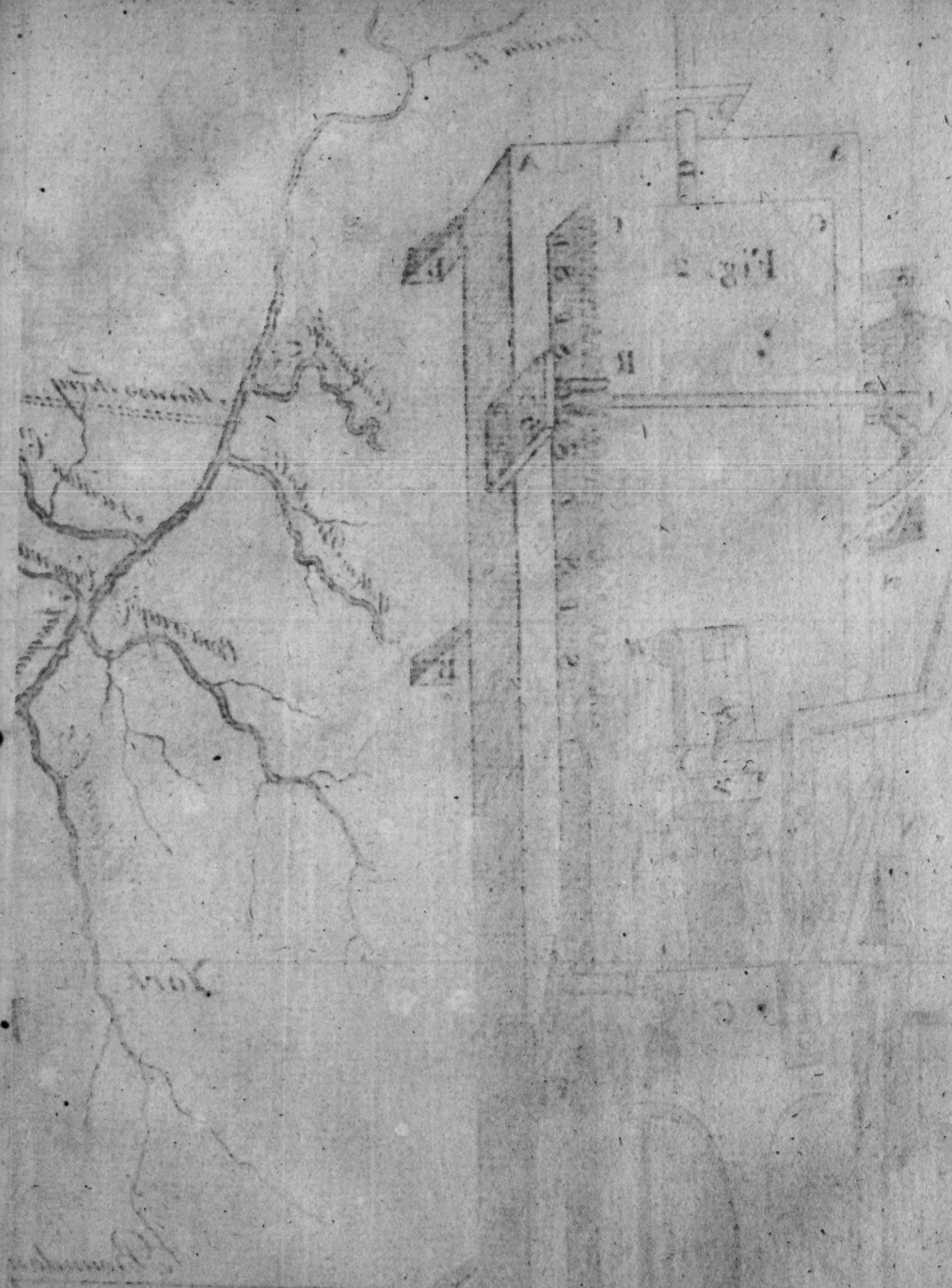
piston or spear a quarter the height of what is required in a four inch bore for a piston moving three inches in an eight inch bore, and twelve inches in a four inch bore, will deliver just about the same quantity of water. It will be further objected, that in stormy weather, when vessels generally make the most water, the wheel could not be put overboard. I own there is some force in this objection, but if a remedy is beneficial in some cases, though not adequate in all, it ought not to be totally rejected. Many leaks happen at sea in moderate weather, and even those which are occasioned by damage in a storm, often continue when the waves are abated. Sailors are frequently unhappily washed overboard, and possibly those who may have survived the storm, are too few, and too weak, to keep the ship clear of water, and perform the other necessary duties on board, in such cases this machine would be evidently useful. It may also be urged, that the wind at such time may be so much a head, that the ship cannot make way enough through the water to work the pumps; to which I reply, when life is in danger, when grim death stares the affrighted crew in the face, the port of destination is not to be considered, but the vessel must be steered for that shore, which best suits the working of the pumps, and keeping her above water.

I would therefore propose, that every vessel should not only have pumps of eight inches bore, but be provided with a shaft, crank, and proper wheels, which might easily be stowed away in little room, as the paddles of the water wheel may be unshipped, and the whole procured at a small expence.

THESE hints, together with the model, I submit to the inspection of the Society, and hope some improvement may be made on this plan, which will prove useful to mankind.

R E F E R E N C E S. Plate VI. fig. II.

A. Top-Mast or Shaft of the Wheel. B. Oars or Arms of the Wheel. C. Crank. D. Pump. E. Props on the Deck, to support the Shaft.



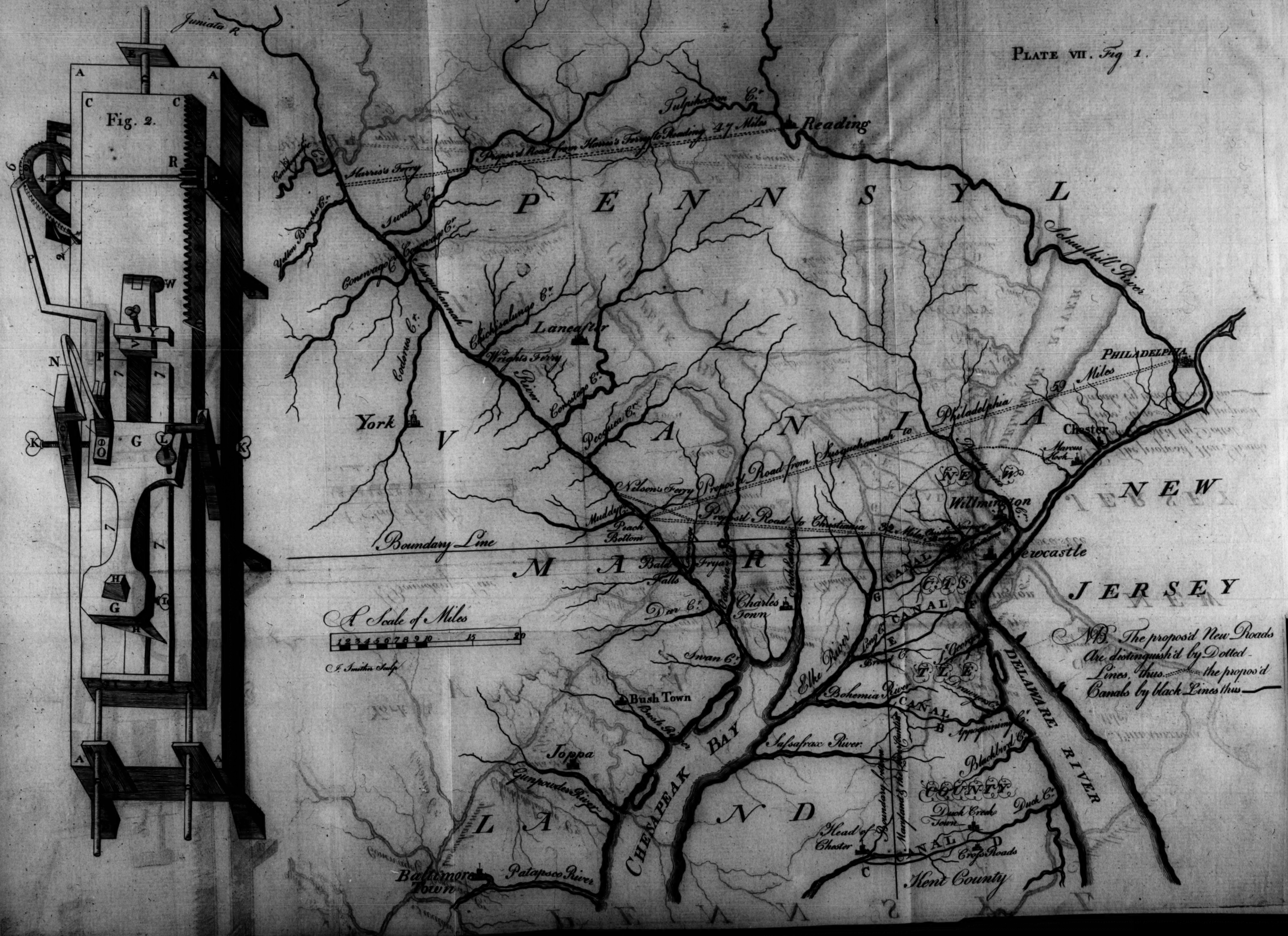
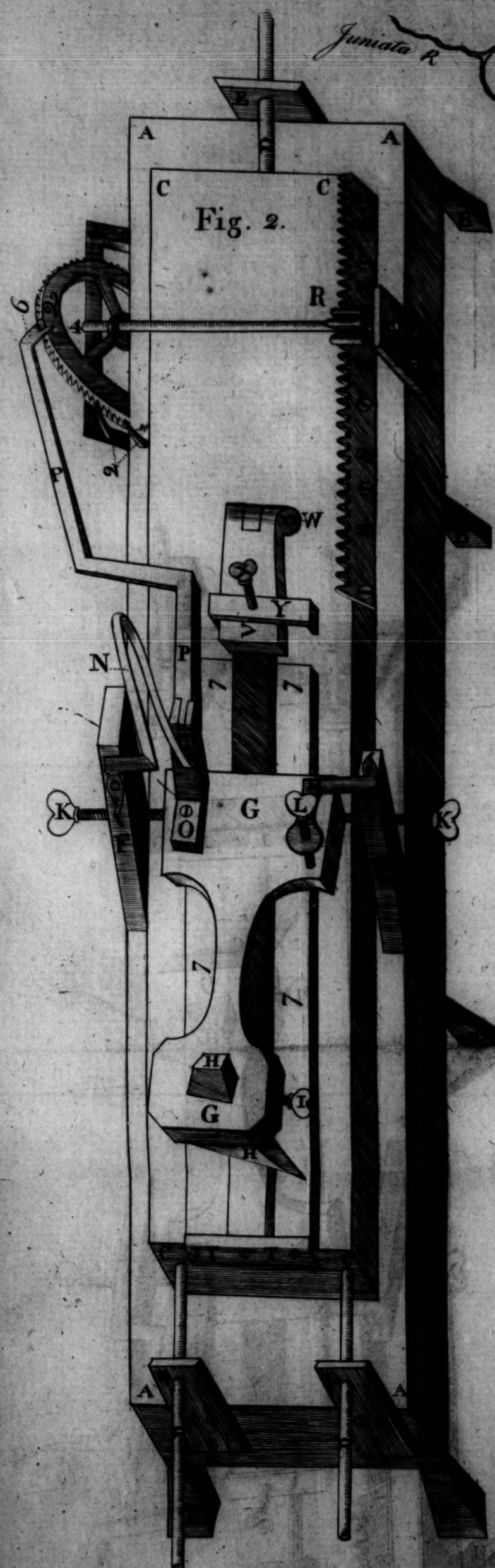
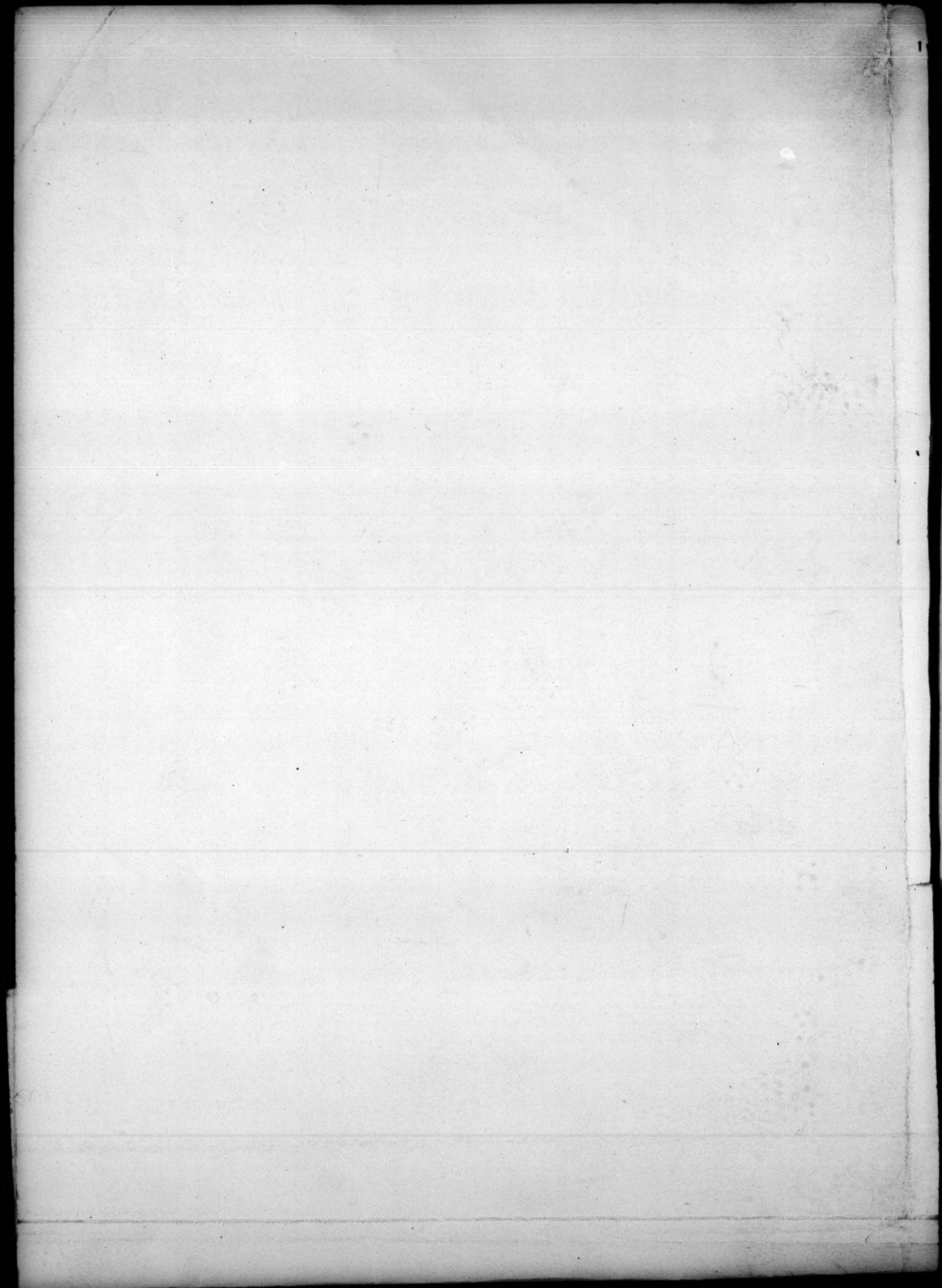


Fig. 2.





An ABSTRACT of sundry Papers and Proposals for improving the Inland Navigation of Pennsylvania and Maryland, by opening a Communication between the Tide-Waters of Delaware and Susquehannab, or Chesapeake Bay; with a Scheme for an easy and short Land-Communication between the Waters of Susquehannab and Christiana-Greek, a Branch of Delaware; to which are annexed some Estimates of Expence, &c.

THE American Philosophical Society, held at Philadelphia, have always considered it is one great end of their Institution, to set on foot, and forward the execution of, such public-spirited undertakings, as have a tendency to advance the landed and commercial interest of the British Colonies in general, and particularly of those Middle Colonies, with which they are more immediately connected.

WITH this view it was, that they appointed different Committees, to view the ground, and consider in what manner a water communication might be best opened, between the Provinces of Maryland and Pennsylvania; and particularly by what means the large and increasing number of frontier-settlers, especially those on the Sasquehannah and its branches, might be enabled to bring their produce to market at the cheapest rate, whether by land or water. To enable the Society to make these surveys, levels, &c. the Merchants in Philadelphia generously subscribed near Two hundred Pounds.

THE first place proposed to be viewed, was the ground between the tide-waters of *Apoquiniminck* and *Bohemia*, marked AB in the annexed map (Plate VII.) and John Lukens, Esq; Surveyor-General, John Sellers, Matthew Clarkson, and Joseph Ellicot, Esqrs. Messrs. Thomas Gilpin, Richard Sittiforth, William Killen, John Stapler, of Pennsylvania, and William Rumsey, Esq; of Maryland, were appointed a Committee for this service, May 5th, 1769; who having performed the same, their Report, signed by the three first named Gentlemen, was given in to the Society, June 19th, 1769, setting forth, "That they had viewed the ground aforesaid, taken the levels, surveyed the distance, and essayed a calculation of
P p " the

“ the expence, which would attend the cutting a CANAL in
 “ that place, which they were of opinion might be executed
 “ with LOCKS for the sum of *Forty Thousand Pounds*.* Penn-
 “ sylvania money.

“ THE depth of earth from the highest ground to the level
 “ of navigation being very great, they declined making any
 “ estimate of what the cost would be, to make a clear passage
 “ from river to river, without LOCKS, judging it an under-
 “ taking beyond our present abilities.”

THE whole length of the ground where this Canal is pro-
 posed, from tide to tide, is 5 miles 107 perches. They found
 the waters in the Head Branch of Bohemia about eighteen feet
 below the surface of the highest ground, through which the
 Canal must go, and the water in the Head Branch of Apoqui-
 niminck, about twenty-six feet below the same. The tide-
 waters are sixty-six feet below the highest ground.

THEY found that for making a *Lock-Navigation* (under the
 above circumstances) 208805 cubic yards of earth must be re-
 moved, that 10,260 perches of stone-wall would be necessary
 for securing the banks of the Canal; that three mills must be
 purchased that stand in the way of the execution of the plan, and
 that six *Locks* must be erected; all which, they judge, might
 be done at the expence of Forty Thousand Pounds, as aforesaid.

MR. Thomas Gilpin, one of the above Committee, laid be-
 fore the Society a plan of a Canal, and the elevation of the
 ground, &c. between Chester River, in Maryland, and Duck-
 Creek, in Pennsylvania, at the place marked CD, in the an-
 nexed map. “ The distance from tide to tide is here about
 “ twelve miles, and the length of the Canal, by the courses it
 “ must take, would be fourteen miles. The height of the
 “ middle ground above the tide is thirty-three feet;” and he
 reports, “ that the water in Chester River and Duck Creek
 “ is sufficient to supply the Canal and Locks to the height of
 “ twenty-two feet above the tides. He estimates only about
 “ Eight

* One Spanish milled Dollar passes in Pennsylvania for Seven Shillings and Six-Pence;
 by which all estimates in the currency of that Province may be turned into Sterling.

“ Eight Thousand and Fifty Pounds for making a navigation
 “ for flat-bottomed boats, that would carry one thousand
 “ bushels of wheat each; but to make it fit for shallops, with
 “ a Lock-Navigation, he states the whole expence at Twenty-
 “ Eight Thousand Two-Hundred and Ninety-Eight Pounds.”

SEVERAL difficulties having been apprehended in both the above Plans, and particularly the great expence in executing the first to any advantage; and that if the second could be executed at the expence proposed, it would carry all the navigation of the river Susquehannah (which is the great object in view,) too far down into Chesopeak-Bay, for an advantageous communication with Philadelphia; it was therefore proposed, that some other places should be examined, by which the water carriage between Susquehannah and Delaware might be rendered shorter, and more practicable.

COMMITTEES were accordingly appointed to examine, survey and level the ground, between the navigable waters of Delaware River in Pennsylvania, and Elk River that empties into Chesopeake, near the mouth of Susquehannah. This service was completed by the Committee with great diligence, and in the extremity of winter, as they found it best to proceed when the surface of the waters and marshes were frozen over. Their *Report* was delivered to the Society, 16th February, 1770; an Abstract of which follows, viz.

“ THAT they had divided themselves into two parties for
 “ the greater expedition; one of which parties, viz. Samuel
 “ Rhoads, Esq; the Revd. Mr. John Ewing, Messrs. Richard Sittiforth, and Joseph Horatio Anderson, undertook
 “ to survey and level the ground between the tide water of
 “ Red Lion Creek, which empties into the Bay of Delaware
 “ about six miles below New-Castle, and the tide water of
 “ Long Creek, which is a branch of Elk-River, (the ground
 “ marked EF, in the plan). The other party, consisting of
 “ Messrs. John Stapler, Joel Bailey, Thomas Gilpin, and
 “ Levi Hollingsworth, undertook to survey and level the
 “ ground marked GH, between the navigable waters of
 “ Christiana Creek, which empties into Delaware about four
 “ miles above New-Castle, and the Head of Elk River.

THE work being finished, they report further, "That they find it a very easy and practicable matter to cut a Canal in either of the above places, sufficiently large to answer the purpose of a Barge Navigation, as it is called, and that at a moderate expence. Or if a Lock Navigation should be thought more eligible, as by that means the same vessels that bring the produce and merchandize to the Canals, may proceed to market without unloading, this also (although it might be attended with a greater expence), is also practicable at both the above places."

As to the Barge Navigation, &c. (should that be thought best) they observe that "the ground in both places will admit of a Canal being dug on a level between the tide waters of Delaware and Chesapeake; in which barges may continually ply, loading and unloading at each end; while shallops, boats, and other small craft may come to the ends of the Canal, to bring or carry off the various articles of commerce that may be conveyed through this communication. Warehouses must be built at each end of the Canal, to prevent unnecessary delays, and damage of the goods. The head waters of Christiana and Elk Rivers may be brought in to supply either of these Canals."

THE Committee further report, that when they had completed their surveys, &c. as above; they proceeded, agreeable to their instructions, to Peach Bottom Ferry, on Susquehannah, in order to make the best enquiry they could, concerning the different Falls and Rifts in that River; and to examine where the best and shortest road could be made from that place to Christiana Bridge.

WITH respect to the different Falls, they report, from the best information they could obtain, "That the *Bald Friar Falls*, are the most difficult to pass in that river. These lie in Maryland, about three miles below the Southern boundary of this Province; that the other Falls are often passed in canoes, flats, rafts, &c. that they all disappear in the time of a fresh, and therefore may be passed with the greatest safety, and that in the intermediate parts of the river, the cur-

"rent

"rent is so slow and gentle, that it is easy to row, or even sail
 "against it. From the great quantity of water which this
 "river contains, it appears obvious, that with a very mo-
 "derate expence a Channel may be opened through the fe-
 "veral Falls, by blowing up a few rocks, so as to make a
 "good navigation, without doing any detriment to the other
 "parts of the river by lessening its depth; or where it may be
 "judged more expedient, a small Canal may be cut on the
 "shore, so as to avoid all difficulty and danger from them.
 "They cannot ascertain the expence of this work with preci-
 "sion, but they apprehend it will not amount to more than
 "Four Thousand Pounds."

WITH respect to the road, they add, "That from the
 "mouth of Peters's Creek, (which empties into Susquehan-
 "nah, at Peach Bottom, about three miles above the boun-
 "dary line of the Province, and where a very convenient
 "harbour may be made for boats,) they had examined the
 "ground, and find a good road may be made from thence to
 "Christiana-Bridge, by an easy ascent along the valley of this
 "creek, which extends about two miles from the river in a
 "direction nearly parallel to the said West line. The ground
 "admits of a good road from this to the place where the said
 "boundary line crosses Octorara Creek, near the Horse-
 "Shoe Ford; after which it may be continued near the said
 "line until it meets with the boundary of New-Castle County.
 "That part of the road which lies in New-Castle County is
 "already made, and there is a law in that government, for
 "keeping it in good repair. There are no hills to obstruct
 "it, except at Octorara Creek and Great Elk; the most
 "convenient places of passing which appear to be at Wilkie's
 "Mill, and the abovementioned Horse-Shoe Ford, where the
 "hills may be easily ascended by winding a little on the
 "Pennsylvania side. This road may be made at a small ex-
 "pence, and will reduce the distance between Peach Bottom
 "and the tide waters of Christiana Creek to about *Thirty-two*
 "*Miles*. Bridges must be thrown over the streams of Octora-
 "ra and Elk, as they are frequently so high as not to be
 "forded. The whole expence of this work, they suppose, will
 "not exceed a Thousand or Fifteen Hundred Pounds.

"UPON

“ UPON the whole, they remark, that the river Susquehannah
 “ is the natural channel through which the produce of three-
 “ fourths of this Province must in time be conveyed to mark-
 “ et for exportation, and through which great part of the back
 “ inhabitants will be supplied with foreign commodities.

“ THAT this conveyance will become easy and cheap, to the
 “ settlers above the Peach Bottom or Bald Friar Falls; and
 “ may, by proper encouragement, be found the most useful
 “ and convenient for all the Western trade.

“ THAT a road from Peach Bottom to the navigable waters
 “ of Christiana Creek, will reduce the whole land carriage of
 “ the most remote inhabitants on the various branches of the
 “ Susquehannah to thirty-two miles, which appears to be the
 “ shortest portage from that river, to the navigable branches
 “ of Delaware, which can be had within the limits of this go-
 “ vernment; and that the conveyance from Christiana to
 “ Philadelphia is known to be safe and easy.

“ THAT clearing a channel through the Bald Friar Falls, and
 “ opening a Canal thro’ either of the abovementioned levels,
 “ will not only reduce the whole trade of the Susquehannah
 “ to a water carriage, but will open such a communication
 “ between the Delaware, and all the rivers of the Chesapeake-
 “ Bay, as will greatly advance the commercial interest of all
 “ the colonies adjoining thereon, by reducing the expence of
 “ carriage, on the various articles of traffic, which are yearly
 “ transported from one Province to another, through these
 “ extensive waters.”

R E M A R K S.

First, WITH respect to the water communication proposed
 from the mouth of Red-Lion Creek on Delaware, below New-
 Castle, to the navigable branches of Elk-River, at the place
 marked EF, it appears from the drafts, &c. that the same may
 be executed by cutting either from Long-Creek or Broad-
 Creek.

THE

THE length of the Canal, if from Long-Creek to Delaware, is 10 miles, 135 perches; if from Broad-Creek to Ditto, it is 9 miles, 200 perches; and either of these Canals leads immediately into Delaware.

THE Committee declare themselves fully satisfied, that a good Canal, either for a Barge or Lock Navigation, may be made in this place, through one of the hollows adjoining the ridge on which they carried their level, at a less expence than at any place of equal convenience. The severity of the season did not permit them to carry their level along either of these hollows, or to examine the soil so strictly, as that they could pretend to make an accurate estimate of the expence. But, by the best judgment they could form, the ground to be dug and moved for a Barge Navigation, is about 420,000 cubic yards, and the whole expence of this and the other work necessary for a Barge Navigation in this place, they estimate at £. 14,426.

Secondly, WITH respect to the Canal proposed from Elk-River to the navigable waters of Christiana-Creek, near the bridge, at the place marked GH; the distance or length of the same, by the different courses, is 12 miles, 10 perches. The height of the heighest ground above the level of the tide is sixty-eight feet and a half.

THE ground to be dug and moved, for a Barge Navigation, they make 387860 cubic yards.

AND the whole expence of compleating the Canal,

For a Barge Navigation,	£. 19,396 : 10
THE additional expence for a Lock Navigation	40,924 : 10

Total for a Lock Navigation,	£. 60,321
------------------------------	-----------

THE difference between the expence of a Barge and Lock Navigation being so great, the Committee therefore recommend the former for the present.

THE particular estimates upon which the foregoing Abstract is founded, together with the Plans of Surveys, Elevations of the Ground, and Drafts of the different proposed Canals, being

Being too large to be inserted in the Transactions of the Society, are therefore lodged in their Cabinet for the inspection of those who may desire further satisfaction, in regard to the Practicability of carrying either of the above schemes into execution, which on a due consideration of all circumstances may be judged most for the public service.

In the mean time, the immediate opening the proposed new road from Peach-Bottom on Susquehannah, to the tide waters of Cristiana Creek, is recommended as a matter of the utmost importance, not only to the city of Philadelphia, but to a great part of the settlers on the waters of Susquehannah.

To the AMERICAN PHILOSOPHICAL SOCIETY, &c.

A Description of a MACHINE for cutting FILES, a Model of which was presented the Society some Time ago.

By B. O.

R E F E R E N C E S.

A BENCH, made of well seasoned oak, and the face of it plained very smooth. *AAAA*. (Plate VII. Fig. 2.)

BBBBB, THE feet to the bench which should be substantial.

CCCC, THE carriage on which the files are laid, which moves along the face of the bench *AAAA*, parallel to its sides, and carries the files gradually under the edge of the chisel *HH*, while the teeth are cut: This carriage is made to move by a contrivance somewhat similar to that which carries the log against the saw of a saw mill, as will be more particularly described.

DDD, ARE three iron rods, inverted into the ends of the carriage *CCCC*, and which passes through holes in the studs *EEE*, that are screwed firmly against the ends of the bench *AAAA*, for directing the course of the carriage *CCCC* parallel to the sides of the said bench.

FF, Two

FF, Two upright pillars, mortised firmly into the bench *AAAA*, nearly equi-distant from each end thereof, near the edge, and directly opposite to each other.

GG, The lever or arm, which carries the cutter *HH*, and works on the centers of two screws *KK*, which are fixed into the two pillars *FF*, in a direction right across the bench *AAAA*. By tightening or loosening these screws, the arm which carries the chisel, may be made to work more or less steady.

L, Is the regulating screw, by means of which the files may be made coarser or finer; this screw works in a stud *M*, which is screwed firmly upon the top of the pillar *F*. The lower end of the screw *L*, bears against the upper part of the arm *GG*, and limits the height which it can rise.

N, A STEEL spring that is screwed to the other pillar *F*, by one end, the other end of which presses against a pillar *O*, that is fixed upon the arm *GG*, and by its pressure forces the said arm upwards, until it meets with the regulating screw *L*.

P, Is an arm with a claw at the end, marked 6, the other end is fixed by a joint into the end of the stud or pillar *O*, and by the motion of the arm *GG*, is made to move the ratch-wheel *Q*; this ratch-wheel is fixed upon an axis, which carries a small trundle head or pinion *R*, on the opposite end; this takes into a piece *SSSSS*, which is indented with teeth, and screwed firmly against one side of the carriage *CCCC*, and by means of this the carriage has a motion communicated to it.

TT, Is a clamp for fastening one end of the file in the place or bed on which it is to be cut.

V, Is another clamp or dog at the opposite end, which works by a joint *W*, firmly fixed into the carriage *CCCC*.

X, A BRIDGE, likewise screwed into the carriage, through which the screw *X* passes, and presses with its lower end against the upper side of the clamp *V*, under which clamp the other end of the file *ZZ*, is placed and held firmly in its place, while it is cutting, by the pressure of the said clamp or dog *V*.

7, 7, 7, 7, Is a bed of lead, which is let into a cavity that is formed in the body of the carriage, something broader and longer than the largest sized files; the upper face of this bed of lead is formed variously, so as to fit the different kinds of files which may be required.

2, Two catches, which takes into the teeth of the ratch-wheel $\mathcal{Q}$, to prevent a recoil of its motion.

3, 3, Is a bridge to support one end of the axis 4, of the ratch-wheel $\mathcal{Q}$.

5, A Stud to support the other end of the axis of the ratch-wheel, $\mathcal{Q}$.

WHEN the file or files are laid in their place, the machine must be regulated to cut them of the due degree of fineness, by means of the regulating screw, L , which, by screwing it further through the arm, M , will make the files finer, and vice versa, by unscrewing it a little, will make them coarser; for the arm GG , can by that means, have liberty to rise the higher, which will occasion the arm PP , with the claw, to move further along the periphery of the ratch-wheel, and consequently communicate a more extensive motion to the carriage $CCCC$, and make the files coarser.

WHEN the machine is thus adjusted, a blind man might cut a file with more exactness than can be done in the usual method with the keenest sight; for, by striking with a hammer on the head of the cutter or chisel HH , all the movements are set at work; and, by repeating the stroke with the hammer, the files on one side will at length be cut; then they must be turned, and the operation repeated, for cutting the other side. It is needless to enlarge much on the utility or extent of this machine; for, on an examination, it will appear to persons of but an indifferent mechanical skill, that it may be made to work by water as readily as by hand, to cut coarse or fine, large or small files, or any number at a time; but it may be more particularly useful for cutting very fine small files for Watchmakers, as they may be executed by this machine with the greatest equality and nicety imaginable: And as to the materials and dimensions of the several parts, I shall leave that to the judgment and skill of the artist, who may have occasion to make one, only observing, that the whole should be capable to bear a good deal of violence.

TRANSACTIONS OF THE

American PHILOSOPHICAL SOCIETY.

SECT. IV.

MEDICAL PAPERS.

An Analysis of the CHALYBIATE WATERS of BRISTOL, in Pennsylvania; in Two Letters from Dr. JOHN DE NORMANDIE, of Bristol, addressed to Dr. THOMAS BOND, one of the Vice Presidents of the American Philosophical Society, held at Philadelphia; and by him communicated to the said Society.

L E T T E R I.

Bristol, in Pennsylvania, September 10, 1768.

DEAR SIR,

ON seeing amongst the many useful purposes of instituting the American Philosophical Society, that of communicating to the public new methods of curing and preventing diseases, is deservedly included; I take the liberty of requesting you to present my most respectful compliments to the worthy Members of it, and beg their favourable acceptance of the inclosed Analysis of the Bristol Mineral Water, and of an account of the means whereby a village, long unhealthy, has been rendered remarkably healthy.

Qq 2

To

*To the AMERICAN PHILOSOPHICAL SOCIETY, held at
Philadelphia, &c.*

TH E great improvements the last and the present age have made in the healing art, the encouragement given to the study of Physic by the establishment of medical schools in North-America, and especially in your city, where the several branches of medicine are regularly taught, must afford the most sensible pleasure to every humane disposition, and prove an encouragement to all who are interested in the health of their fellow creatures, to exert themselves in pursuing every discovery which may tend to the relief of the sick; or the reinstatement of an impaired constitution.

FROM these considerations, I have undertaken to try the following experiments upon the Chalybeate Waters of Bristol, in Pennsylvania, with a view to discover their contents, as a guide to the further investigation of their virtues and uses; and particularly, their application in the cure of diseases. For although it must be confessed, that a chemical analysis is, in some measure, an uncertain test of the medical virtues of any compound; and that the qualities of its constituent parts, when separated, may not only differ from, but are sometimes opposite to, those of the mixture; yet when we want the testimony of experience, a chemical analysis is the best means of investigating the truth, and discovering the virtues of the compound.

THUS, if from the following experiments it shall be found that the waters of Bristol, are impregnated with the principles of those of Bath or Spa, it will be no forced conclusion to say, they may be beneficial in cases similar to these that have been happily cured by the latter.

EXPERIMENT I. A small portion of white-oak bark, infused in the waters, induced an immediate change from transparency to a dark purple colour, which it retained 24 hours, without depositing any sediment.

II. SOME

II. SOME of the same water, after being made hot, or exposed for a few hours to the open air, in a great measure lost its iron taste, and received no other colour than a common tincture from the white oak bark.

III. ONE drop of strong oil of vitriol, in two ounces of the water, produced no sensible alteration; and the water after standing some time continued transparent, without depositing any okerish or other sediment to the sides or bottom.

IV. OL. TART. pr. deliq. dropt in some of the same water, induced a change in the colour, rendering it somewhat yellow; and in time precipitated to the bottom of the cup a fine gold coloured oker.

V. SIXTEEN ounces avoirdupois, carefully evaporated to a dryness in a China bowl in B. M. left one grain of a yellowish brown powder of the taste of tart. tartariz.

VI. LINEN, moistened with the scum floating on the top of the spring, is tinged with a strong iron mold.

VII. THIS water in weight is exactly the same as that of rain water.

FROM these few experiments, it is sufficiently evident that this water, in its natural state, contains a large portion of iron dissolved in pure water by means of an acid, which acid is extremely volatile, and probably of the vitriolic kind; principles similar to those of the much celebrated waters of the German Spa, with which they likewise agree in the effects which immediately follow upon drinking them; such as quickening the pulse, exciting an agreeable warmth in the stomach, promoting the appetite, and occasioning a flow of spirits, and a greater degree of chearfulness.

HENCE we may justly conclude, that like those they will be very beneficial in all that numerous train of diseases, which arise from a debilitated and relaxed state of the solid parts of the human body, brought on by living in warm climates, immoderate

derate evacuations, &c. such as hypochondrical complaints, melancholy, loss of appetite, and indigestion, with habitual sickness, and pains of the stomach and bowels, and all their unhappy consequences; rickets, lameness, and some paralytic complaints; and that they will likewise prove powerful deobstruents and alteratives, opening obstructions, and discharging what is obnoxious by the several emunctories.

NOR indeed are these virtues attributed to them from conjecture and analogy only; but, in some measure, from the testimony of fact and experience. For although it would not be very easy, till the waters become more generally known, to collect any number of accurate and well attested cases, yet, from the strictest enquiry from persons who have spent their lives, near these springs, it is certain they have, for a long time, been remarkable for their salutary effects, strengthening the stomach, restoring lost appetite, &c. And that numbers have left the place perfectly cured of diseases which, for many years, had eluded the most powerful remedies.

BUT as Bristol was formerly an unhealthy place, and prejudices against it may still remain in the minds of numbers of persons, who otherwise would be willing to try the benefits of these waters, it may not be improper to assign the causes why it was then so, and how from their removal, it is now become an exceeding healthy spot.

THE town of Bristol is situate on a high dry bank, with the river Delaware to the eastward and southward. There is a quantity of low ground to the southward and westward, which, in its natural state, was overflowed by every spring tide; to the northwest there is a large pond of water, which, when filled by the winter's rain, overflowed the neighbouring hollow clayey ground, and there remained stagnant, until exhaled by the succeeding warmer seasons, which was seldom before the middle of autumn; at which time agues, remitting, intermitting, and continued fevers, and indeed every species of autumnal disorders, prevailed, not only amongst strangers, but even the inhabitants. This continued to be the case until the owners of the low marshy grounds, to the southward and westward of the town,

town, embanked and improved them; and a few public spirited inhabitants employed persons to cut ditches to drain off the superfluous water, as it flowed out of the pond. After these improvements, the place became healthy; the inhabitants were no longer particularly subject to fevers of any kind, and, for several years past, have enjoyed as much health, as any people in any part of America.

L E T T E R II.

S I R,

SOME months ago, in a Letter to you (communicated to the Public by the Philosophical Society) I gave you a short analysis of the Bristol Chalybiate Waters.

I HAVE since had opportunities of prosecuting that subject farther, by a number of additional experiments, which, together with the histories of several cases, that have occurred in my attendance here, will more clearly ascertain the contents of these waters, and determine the effects which may be expected from their use, in the cure of diseases.

I THEREFORE take the liberty to transmit you the following account, which I flatter myself, will be favourably received as an useful supplement to my former Letter.

THE experiments I related to you in my last, tended chiefly to shew that these waters owed their chief impregnation to iron kept in solution, by means of an acid, which I judged to be of the vitriolic kind.

THOSE which I am now to communicate to you confirm this opinion, and at the same time discover some other principles, in their composition, with which I was before unacquainted, and which probably increase their medical virtues.

Experiment I. UPON the addition of Sp. Sal. Arom. to the water a slight effervescence ensued, and upon standing about an hour, a light yellow matter was separated and floated on the top of the liquor.

II. FROM

II. FROM a mixture of lime water, the same separation was made, but fell to the bottom of the liquor.

III. POWDER'D chalk added to the water produced the same separation, but not in so short a time, as in the preceeding experiments.

IV. THE residuum, after a slight calcination, was strongly attracted by the Magnet.

V. A SOLUTION of crude Sal. Ammon. being mixed with the water, was succeeded by the same appearance as the addition of lime-water.

VI. THE residuum after evaporation in Baln. Mar. before calcination, discovered to the taste a considerable portion of Salt, which left a coldness on the tongue, and when separated by solution, filtration and evaporation, appeared of the colour of salt of amber, and shott into right angled crystals, which through a microscope appeared beautifully feathered; and from every experiment was found perfectly neutral.

VII. SILVER immersed for some time in the water acquired a slight yellow colour.

VII. THE residuum thrown on a red hot iron sparkled very much, and emitted a sulphureous smell, what remained on the iron had not the least perceptible taste of salt.

IX. THE waters, and the solution of the crystalized salt, changed syrup of violets, to a fine light green.

THE first four of these experiments, in which the waters were decomposed as well by a volatile alkali, as by lime water, and an absorbent earth, and the residuum (after a slight calcination) being attracted by the Magnet, evidently prove that they are impregnated with a considerable portion of iron.

THE fifth experiment (in which a decomposition takes place by means of a double elective attraction) shews that the acid

in these waters, has a stronger affinity with alkalies, than that which is the basis of Sal. Ammoniac, (which is the marine acid,) and must be either the nitrous or vitriolic. And from a decomposition taking place, on the addition of common nitre with the Chalybiat Waters, in about the same time as when left exposed in the open air, we may rationally conclude the acid to be of the vitriolic kind.

THE sixth experiment shews that there is a small portion of neutral salts in these waters, which from the coldness with which they effect the tongue, and the appearance of the crystals, are probably of the ammoniacal kind.

THE seventh and eighth experiments together with the smell of the bath and the considerable factor which the waters acquire when kept for any time, evidently shew that they contain a third principle, which is sulphur. This indeed (as well as the salt) is in a small quantity, yet it may contribute somewhat to the medicinal virtues of these Springs.

THE ninth experiment seems to prove them to tend rather to an alkaline nature, but as this was in a very trifling degree, it may be accounted for from the escape of the acid which is extremely volatile.

THESE experiments compared with those I have already communicated to you sufficiently discover the constituent parts of these Waters.

FROM some other experiments I find they instantly lather with soap, are somewhat lighter than common water, that they no ways coagulate milk, even when boiled with it, and that when mixed with an equal quantity of it, they prevent in some measure its acescency; from the first and second of which facts, we may naturally suppose them more powerfully deobstruent, and from the two last we may draw this useful corollary, that they may not only be used with safety along with a milk diet, but that they really in a chemical sense prevent the ill consequences which often attend such a diet in a weak stomach. From this circumstance their efficacy must be in many cases greatly increased.

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WHEN drank, they act as a quick diuretic, always increasing the quantity of urine. They generally at first drinking prove cathartic, always tinge the excrements black, and sometimes, from the state of the stomach prove emetic. They exhilarate the spirits, and in some instances produce a momentary intoxication. They communicate an immediate vigor and strength to the whole constitution, as is evident to many patients, who with fatigue walk to the wells; but in returning home, are not sensible of any weariness or languor.

THEY promote digestion, strengthen the stomach, and create an appetite. These are their constant and immediate effects in almost every state of the body, from which one might reasonably conclude, that they would be highly beneficial in many diseases. But as the best test of their utility are facts, I shall select some few out of those cases, which this season has already afforded me.

Case 1st. W. A. A LABOURING man, of a fallow dusky complexion, who for twelve years past, had been afflicted with phagedenic ulcers in his legs, and for the last eight years a schirrous liver and spleen, for which the most powerful deobstruent, aperient, and alterative medicines had been prescribed without effect, was employed in sinking the Bath, and digging drains, to carry off the waste water for ten days, during which time he was generally up to his knees in mud, ochre, and water. In that time the ulcers on his legs intirely healed up, without the use of any kind of medicine or dressing, except a piece of linen cloth over the sores. He was then retained as bath-keeper, in which station his business led him into the bath several times every day; and in eight weeks (during which time he constantly drank the Waters) the disorder in his liver and spleen gradually gave way; and at this time, without the use of any medicine, he has perfectly recovered his health and complexion. To him the waters at first proved gently purgative, and afterwards diuretic.

2d. W. W. AGED about nineteen years, for two years past had been afflicted with violent rheumatic complaints, to such a degree that at the time of his coming to the Bath it was with difficulty

difficulty he could raise himself when seated, and the muscles of his neck were so rigid and contracted that he could not move his head; he found sensible benefit from the first use of the Bath, and by continuing it for about seven weeks, perfectly recovered his health, and the use of his limbs.

3d. *L. M.* HAD for near two years been afflicted with a weakness at his stomach, inability in the organs of digestion to perform their office, and at times a general lassitude and weariness over every part of his body, brought on by too violent exercise. Upon drinking and bathing a short time, he received very sensible benefit, all his complaints ceased, and he gained a much better appetite than he had ever experienced while laboring under his disorder.

4th. *Mrs. H.* FOR five years had been afflicted with a violent cough, attended with pain in her breast and a hectic fever, which never had abated from the use of medicine. By drinking and bathing for four weeks, she perfectly recovered her health without any medicine, and returned home with a very good appetite.

5th. *Miss R.* FOR two years past had been subject to pains in her stomach and head, obstructions in her liver, slight cough, perpetually feverish, with loss of appetite, and restless nights, for which a variety of medicines had ineffectually been used, they only affording a temporary relief. In this state she came to the Wells, in so low a condition that she could not walk the length of a street but with the greatest difficulty. At first she daily rode to the Bath, but after using it for some time, so far recovered, that she could walk without any inconvenience, and after staying about five weeks, returned home very hearty, had a good appetite, and rested well.

6th. *J. F.* FOR the last five months subject to an incessant cough, the effect of a violent cold, came to the Wells and drank the waters for ten days, in which time his cough by degrees abated, and he returned home perfectly cured.

7th.

7th. Mrs. K. HAD complaints similar to those mentioned in the case of Miss R, but attended with frequent acrid, black stools, which afforded no relief from her complaints. She drank the waters, and went into the bath for five weeks, in which time she recovered her complexion and flesh, and a much better state of health, than she had enjoyed for a number of years.

8th. Miss H. ABOUT five weeks before she was brought to the bath, was seized with spasmodic contractions in her left arm, a paralytic complaint over all the same side, her speech was much affected, one side of her mouth drawn up, and she had hardly any power over one hand and foot, from which the best adapted medicines and the use of a common cold bath had afforded no relief. Immediately on using the Chalybate bath, her spasms began to abate, and soon left her. She still remains at Bath, has perfectly recovered her speech, and at this time, without the strictest examination, you cannot discover the least remains of her disorder; she can now work with her needle, and dress herself as usual. She took some few nervous stimulating medicines during the time of bathing.

9th. Mr. D. WHO had been for some years constantly subject to a nervous cholic, which rendered his life a burthen to him, came to Bristol, and, after using the bath and drinking the Waters for two weeks, left the place perfectly cured without the use of any other medicine.

10th. Mrs. ---- FOR the last twelve years of her life was subject to obstructions in her liver, attended with an almost constant menstruation, loss of appetite, Oedematous swelling in her legs and feet, and disturbed and restless nights. At the solicitation of her friends, she came to Bristol with a constitution almost wore down, and with a prepossession that her case did not admit of any relief. After a short time bathing, and drinking the waters, the swelling in her feet and legs abated, her appetite and sleep returned, the disorder in her liver, and every other complaint abated, her colour returned, and she now enjoys a much better state of health than she had experienced for a number of years, with the pleasing prospect of a perfect recovery.

FROM

FROM these cases, as well as from the sensible effects upon first drinking these waters, it is evident that they are a safe and active Chalybate, exerting the most powerful effects upon the human constitution, and agreeing with the most delicate subjects; and that they are safely and successfully drank in many cases where the common and usual preparations of iron are attended with dangerous consequences; which perhaps may be owing to the extream subtlety and minuteness of its parts, and the interposition of so large a quantity of pure water; or it may possibly depend on the nature of the mixture, which cannot easily be imitated by any artificial preparation.

IN particular, these cases teach us, that the most happy effects are to be expected from these waters in old and obstinate ulcers, which they quickly and readily dispose to heal. That they penetrate the most remote and minute vessels of the body, prove powerful deobstruents, and remove the most obstinate of diseases, glandulous obstructions, even after they had resisted the most powerful medicines. And hence they may prove highly beneficial in strumous and scrofulous cases of children, in jaundice, and other obstructions of the liver, spleen, and mesenteric glands, which lay the foundation for so many and such obstinate chronicle complaints; as also in cases of obstructed catamenia, and where, from relaxation, the flow is too abundant.

THEY likewise, as appears from the cases of *W. W.* and *L. M.* cure most obstinate rheumatisms, and that languor and uneasiness which often arise from too violent exercise, and which are nearly allied to the rheumatism.

And however prejudices may operate against the use of Chalybate waters in disorders of the lungs, nothing is more certain than that these I am now treating of, have afforded effectual relief in violent coughs, even where they have been of long standing, and when attended with hectic complaints; as is evident from the cases of Mrs. *H.* Miss *R.* and *J. F.* which last was the only case in which drinking the waters without bathing compleated the cure. Nor indeed is this doctrine of the use of Chalybate waters in pulmonary and hectic complaints intirely new. Morton prescribes them in the Phthisis Pulmonalis.

Pulmonalis, in which he does not stand single. And there have been instances of considerable relief afforded by them even in the last stages of a consumption. Some restrictions and cautions are certainly necessary in their use, but they would be too tedious to mention here, and must be left to the judgement of the physician.

In nervous disorders arising from relaxation, one would naturally expect from them the happiest effects, and in fact they have been found very effectual in palsies and nervous cholicks, as in the cases of Miss H. and Mr. D. In short, these waters, in every disease which arises from that fruitful source of complaints, a relaxed and weakened state of the solids, may with great propriety and truth be termed specific; but in no cases have their good effects been more evident or remarkable, than in a depraved and debilitated state of the organs of digestion, arising from inactivity, and a sedentary life, from continuing too long in warm climates, or from excessive and free living; here the remedy is immediately applied to the seat of the disease, and of consequence must produce the most immediate effects, nor indeed has there been one instance, in which, if properly persevered in, they have failed of affording relief.

EVERY particular here asserted is confirmed by experiments that have been carefully made, and by many cases, from which these few are selected, and in the stating of which the public may rest assured, that the most scrupulous fidelity has been observed, by

Dear Sir,

Yours, &c.

Ox. 6th, 1769.

JOHN DE NORMANDIE.

To Doctor THOMAS BOND.

The Case of a TETANOS and LOCKED JAW, cured by amazing quantities of Opium, by Doctor ARCHIBALD GLOSTER, of St. John's, Antigua; communicated to JOHN MORGAN, M. D. F. R. S. Professor of Physick, in the College of Philadelphia; and by him laid before the American Philosophical Society.

A NEGRO, aged forty years, having suffered the excessive heat of the sun in the day, imprudently laid himself down and slept on the damp Earth in the night. The next morning, he perceived a stiffness in the muscles of his jaws, with a somewhat, painful or rather uneasy sensation in those of the neck; having no other complaint at the time, he was blooded, and had an emollient liniment for the parts affected, and was ordered a lenient purge, *ex Mann. & Sal. Glaub.* This operated immediately.

THE day following the pains in his jaws increased, the muscles of his back and neck were frequently seized with violent spasms, which proceeded to the muscles of his thighs and legs, rendering them quite rigid.

HE could scarcely refrain from crying out at these times, and could not, but with difficulty, open his teeth, so far as to admit a knife between. Luckily for him his under jaw projected naturally beyond the upper jaw, so that his food passed between his teeth, and he had no great difficulty in swallowing liquids. His pulse was slow and small, and his skin was below the natural heat: He had no sleep, for so soon as he dozed, severe spasms would rouse him.

HAVING observed in the London Medical Essays, that these complaints had been successfully treated with free exhibitions of opium, and having before this obstinate case came under my observation relieved patients by very liberal doses of it, I thought nothing in the Materia Medica would be so likely to yield relief in this case. I therefore prescribed on the evening of the second day as follows, viz.

June 7th. R. Pulv: Contrayerv: Comp^t: 3 iſs. Nitro: pur 3;
Campb: Opic pur: ana 3 ſs. M D in P Æ sex.
Cap: unam 3tia quaque horâ.

8th. Hæ.

8th. HE was no better, his stiffness continued with frequent spasms severe and painful. The powders were repeated with $\mathfrak{z}\text{ij}$ of opium.

9th. HE had no sleep, no disturbance in his mind, nor the least affection of the Sensorium Commune which could be attributed to the opium. His powders were repeated as yesterday; he took liquid food, such as weak broths, gruels and ptisans. A general bath was ordered, in which he was put stiff as a stake, and the spine with all the rigid parts were well rubbed after the use of it, with a liniment,

*ex Camph. $\mathfrak{z}\text{i}$. solut: in Ol. Oliv: $\mathfrak{z}\text{vj}$.
Tenet: Tebaic: $\mathfrak{z}\text{ij}$. M:*

10th. THE powders were repeated with $\mathfrak{z}\text{i}$ of opium to be given every two hours as usual.

A PARTICULAR bath likewise, consisting of emollient and discutient herbs, was directed for the muscles of his jaws and neck, which were most severely convulsed; indeed the Masseter muscles were to the touch like wood.

11th. THE patient was no better: I began to despair of him: Emollient clysters were thrown up morning and evening, he being very costive, as well from the use of the opium, as from the effects of the disease. His mind was clear and undisturbed, he had no sleep, nor even drowsiness; nor did there appear any of the usual effects of opium given in much smaller quantities. However I knew that nothing but opium could answer our purpose, and tho' I had gone as great lengths with it as any one in these parts would venture, yet I not only persisted in its use, but increased its quantity to $\mathfrak{z}\text{iss}$. in six powders, using less nitre and camphor.

12th. HAVING taken the last six powders, he thought his spasms recurred less frequently. Yet there was no relaxation of the muscles of the jaws, nor any other favourable alteration. His clysters were repeated, the baths and liniment continued, and his powders were again ordered.

13th.

13th. EVERY thing continued the same. He had no sleep, nor any relaxation of the muscles. His discharges by the clysters were hard dry scybals; his mind was still calm, and not a function of it impaired, or in the least altered. He was wakeful in the day as usual, and in the evening had an inclination to rest, but continued to be disturbed by these dreadful spasms.

STILL between hopes and despair I ordered six powders with two drachms of opium, which was twenty grains of pure solid opium in each dose, to be given every three hours.

14th. HAVING taken all these, he was rather easier, his spasms were less frequent, yet no perceptible relaxation of the muscles of his lower jaw followed. His diet was continued as above. His clyster produced the same discharges as before. He was easier always after the general bath, and the rubbing in of the liniment, all which were continued, and as I had ventured as far with opium as I thought it prudent, I ordered as follows:

℞ Pul. Contray. Comp.	{	ana 3jss.
Cinnab. Antim.		
Opii pur.		
Mosch. Chinens.		

3jss to be divided into six parts, and one to be given every three hours.

15th. He said he was easier, had a very little sleep; his spasms were less frequent, and he was in better spirits. This encouraged me to hope for a relaxation of these cruel spasms, which have been fatal to so many. I therefore boldly returned to the former dose of Opium, and gave 3 ij in the powders with the musk and cinnabar.

16th. THE patient found himself much the same as yesterday. His baths, liniments, clysters, frictions and powders were repeated.

17th. He found himself much easier to day, his powders were repeated, and his spasms were much relaxed every where, except in his right leg which was very painful. The masseters gave way a very little, scarcely perceptible.

S f

18. He

18th. He was much the same as yesterday, having gained however a little ground. The same means were continued, and his powders repeated.

19th. He was rather better, and more free from pain; he could sit up; the muscles of the back part of the body were so far relaxed as to admit of that posture, without much pain. He moved his lower jaw from side to side with some ease. The same powders, &c. were continued.

20th. He could open his mouth so far as to admit my little finger into it, but this was done with a horrid grin, and I was afraid the spasm would return with the effort, which is very common. The medicines were repeated.

21st. He was much in the same condition; still had spasms at greater distances, had some sleep, and said he could eat, but I was unwilling to hazard the experiment. His liquid food was continued, his medicines were repeated, and every thing observed with the same care as before.

22d. He continued to mend; has had some sleep; the masseters were relaxed still more; the spasm recurred less frequently. He complained of lowness of spirits, and was desirous of tobacco to smoke, which was allowed. He had a mixture of four spoonfuls of old rum in a pint of warm water. His powders were ordered as before with 3j of opium, and the usual quantity of musk, to be given every four hours only.

23d. He was much better, had some sleep, opened his mouth, could chew, and still enjoyed a calm undisturbed mind. His powders were repeated with ʒjj of opium which makes fifteen hundred grains of solid opium taken in seventeen days.

24th. He had better rest last night and more sleep than during his illness before. He eat a bit of lamb, could open his mouth no farther than yesterday, but his spasms recurred less frequently. His powders with ʒjj of opium were ordered as before.

25th. He was much better in all respects ; he slept pretty well last night, and could move his legs and arms very freely. There was still a spasm on his masseter muscles, as he could not freely open his mouth. Nothing was ordered but a continuance of his baths, liniments, clysters, frictions. The powders ordered for him yesterday not being yet expended.

26th. He continued to mend, although he had not taken above 20 grains of opium the two preceeding days. There was no alteration in his spirits. The spasms were more relaxed. From this time he was visited less frequently, his medicines given more irregularly, but as he had spasms which recurred now and then till the 15th of July, he had his bath continued, and took about 3 *jss* of musk, and 96 grains of opium in that space.

July 20th. He is now perfectly well, in good spirits, and finds no inconvenience from his preceeding sickness, nor any mischief from the amazing quantity of opium he has swallowed down. It is to be noted that from the 16th he was put upon a course of nervous pills ex G. Assafoetid. and Cinna-
bar of Antimony without any opium.

LEST any person should imagine the opium which was made use of in this case, might not be good, I think proper to add that it was fresh, and appeared to be very good, being procured from Messrs. Bevan, Druggists in London ; and that it always answered to the usual effects of Opium in the common doses, in every other instance, having made sufficient use of it in my practice, to be certain of its quality.

An Account of the Effects of the STRAMMONIUM or Thorn-Apple.

By BENJAMIN RUSH, M. D. Professor of Chemistry, in the College of Philadelphia.

I WAS called to a child, (between three and four years old,) a few days ago, which appeared to be ill with a violent fever, delirium, tremors in her limbs, and a general
Sf 2 eruption

eruption on her skin, accompanied with a considerable swelling, itching and inflammation. As the season for inflammatory diseases was now over, (it being the beginning of August) and as I had neither seen, nor heard, of any cases which bore the least resemblance to this in the city, I acknowledge I was much surprized at it, and knew not what cause to call in, to account for a fever attended with such acute symptoms, at a time of the year, when most of people, especially children, were subject to complaints of a very different nature. As her pulse was pretty full and strong, I immediately ordered her to loose a little blood, and gave her a few laxative medicines. Besides these, I ordered her to be put into a warm bath, and recommended the application of stimulating cataplasms to her feet. The opening medicines operated the evening after I gave them, and brought away a great number of the ascarides worms which I far from thinking were the cause of her disorder, as the symptoms still continued with as much violence as ever. I cannot help remarking here, that two of the most powerful vermifuge medicines we are acquainted with, viz. the *Anthelmia*, or *Worm-Grass* of Jamaica*, and the *Carolina Pink-Root*, are both considerably narcotic, and when taken in too large quantities produce effects somewhat similar to those of the *Strammonium*. Do their vermifuge depend upon their narcotic qualities alone? Are all narcotic substances vermifuge? Or may not they be rendered so, by administering purges after them, in the manner we are directed, after using the *Worm-Grass* and *Pink-Root*? These are questions, which are perhaps foreign to our present subject, and yet when resolved, may have their uses in medicine. But to return; the mother of the child finding most of the remedies we had used ineffectual, informed me for the first time, that they had a quantity of *Strammonium* growing in their garden, where the child generally played, and that she recollected that she had once been disordered in a slight manner, from eating some of the seeds of it. This led me immediately to treat her complaints in a very different manner from that I had formerly done. I gave her a puke of two grains of Tart. Emetic, dissolved in water by spoonfuls. It vomited her several times, but brought

* See Dr. Brown's Natural History of Jamaica.

brought nothing but phlegm from her stomach. After this I gave her sweet oil in large quantities, mixed with a little of the oleum Ricini, which in a little time brought away a great number of the Stramonium seeds. The relief she got from this evacuation, encouraged me to repeat the same medicine, which I did every day for near a week, till I began to flatter myself they were all discharged from the body. But notwithstanding this, she was far from recovering so rapidly as we wished. The tremors still continued in her hands at times; her delirium abated, but it left her stupid and blind. The pupils of her eyes were much dilated, and she caught at the bed cloathes and at every thing around her, in the same manner as a person in the last stage of a fever. As I was persuaded the oil she had taken, had evacuated all such of the seeds as were in the guts, I began to suspect, that her complaints were still kept up by a few seeds which still remained in her stomach. I therefore gave her four grains of tart. emetic, in the manner I formerly mentioned, and had the pleasure to find, that it brought up above 80 of the seeds, the second time it puked her. Finding the stupor and blindness still continue, I repeated the puke, which brought up, above 20 more. Upon this all her complaints vanished, and in a few days she appeared perfectly well.

It may perhaps appear surprizing to some, how so many of the seeds of the Stramonium should be lodged so long in a child's stomach, without producing much worse effects than those we have mentioned, especially when we consider the accounts which Dr. Stork has given us of the effects of a very small quantity of it. In order to account for this, we must remark, that the seeds the child swallowed were of the last year's growth, and were become so dry and hard as to resemble little pieces of horn. Besides the seeds of the narcotic plants in general contain but very little of their virtues; even the seeds of the poppy itself may be taken in large quantities, without producing any of the effects of opium. Dr. Stork's experiments were made entirely with the extract of the Stramonium, two grains of which contain more of the narcotic quality of the plant, than three hundred of the dried seeds.

My

My chief design in relating the above case, is to make two observations, which may be of use in other cases.

1. We learn the wonderful connection between the surface of the skin and the alimentary canal. Eruptions upon the skin are generally attributed to an acrimony in the blood. In the present case we see an eruption occasioned by acrid substances irritating the stomach and bowels. It would be easy to point out several other matters both of a vegetable and animal nature, which produce effects of the same kind almost as soon as they are received into the stomach, and long before they are supposed to have undergone its action, or of being mixed with the blood. It is impossible to tell, what species of the eruptive disease are occasioned by the presence of morbid matter in the primæ viæ; but in all those cases, where it is doubtful, it would not be amiss to suspect it, and to order our medicines accordingly. Dr. Korr (of St. Croix) informed me, that he had once an obstinate humour upon his arm, which alternated with a complaint in his stomach, arising from the too great predominance of an acid, and that he was never able to remove it with all the applications he could use, till he cured the disorder in his stomach by bitter and astringent medicines.

A SECOND observation upon the above case, which I would beg leave to make is, that pukes may often be given to evacuate the contents of the stomach, and notwithstanding they work tolerably well, may not answer the purposes we intended by them. How often do we discover the strongest marks of worms being lodged in the stomach, and yet how seldom are we able to bring them up from thence, by the ordinary pukes we administer. In this, and like cases therefore, it should be our practice to encrease the doses of our vomits, or to give such substances as will destroy the life, or virus of those things we would wish to expel from the stomach. Had the last puke, which I gave to the child, which had eaten the Stramonium seeds, failed of bringing them up, I have no doubt, but what the plentiful use of acids ¶, (which are such powerful antidotes

¶ Since writing the above, I have had the pleasure of hearing from Dr. Thomas Bond, and Dr. Harris, an account of the good effects of Lemon Juice in a similar case, after the strongest pukes had been given to no purpose.

antidotes to other narcotic substances,) would have rendered them harmless. And if we may be allowed to reason from analogy, I think we may presume, that there is scarcely a poisonous substance in nature but what has an antidote provided for it. What these antidotes are, can never be determined by reasoning a priori, but must be found out by experiments alone. Considering the frequency of the accidents which arise from poisons, and the little relief we are able to afford in them, I cannot help thinking an enquiry into this subject a matter of great importance, and well worthy of the attention of the Faculty of Physic.

An ENQUIRY into the Nature, Cause, and Cure of the ANGINA SUFFOCATIVA, or Sore Throat Distemper, as it is commonly called by the Inhabitants of the City and Colony of New-York, &c. By SAMUEL BARD, M. D. and Professor of the Practice of Physic in King's College, New-York; communicated to JOHN MORGAN, M. D. F. R. S. Professor of the Theory and Practice of Physic, in the College of Philadelphia.

“ *AS a faithful and accurate history of diseases, their various symptoms and method of cure, is the most effectual way of promoting the art of healing; Physicians should describe, with the utmost care, the diseases they would treat of, and the good and bad effects of any method or medicines they have used in them. But in a more particular manner is this necessary, when any new and uncommon distemper occurs, of which the peculiar pathognomonic and diagnostic signs should be carefully laid down, and a particular account given of what evacuations, regimen and medicines were useful or hurtful in it.*”

Huxham, on Fevers, P. 267.

FROM a conviction of the truth and importance of these observations, and in obedience to the precept of so great a Man as Huxham, I have determined to attempt the history of a disease which has lately appeared among the children of this city, and which, both as an uncommon, and highly dangerous distemper, well deserves an attentive consideration. In delivering

delivering it therefore; I shall first carefully enumerate the symptoms with which it was attended, and describe the appearances which occurred on inspecting the bodies of such as died of it; and then lay down the method of cure which has been found to be most successful in its treatment.

In general, this disease was confined to children under ten years old, though some few grown persons, particularly women, (while it prevailed) had symptoms very similar to it. Most of those who had it were observed to droop for several days before they were confined. And the first symptoms, in almost every case, were a slightly inflamed and watery eye, a bloated and livid countenance, with a few red eruptions here and there upon the face, and in one case a small ulcer in the nose, whence oozed an ichor so sharp as to inflame and erode the upper lip. At the same time, or very soon after, such as could speak, complained of an uneasy sensation in the throat, but without any great soreness or pain. Upon examining it, the tonsils appeared swelled and slightly inflamed, with a few white specks upon them, which, in some, increased so as to cover them all over with one general slough; but this, altho' a frequent symptom, did not invariably attend the disease; and some had all the other symptoms without it. The breath was either no ways offensive, or had only that kind of smell which is occasioned by worms; and the swallowing was very little, if at all, impeded.

THESE symptoms, with a slight fever at night, continued in some for five or six days, without alarming their friends; in others a difficulty of breathing came on within twenty four hours, especially in the time of sleep, and was often suddenly increased to so great a degree as to threaten immediate suffocation. In general, however, it came on later, increased more gradually, and was not constant; but the patient would now and then enjoy an interval of an hour or two, in which he breathed with ease, and then again a laborious breathing would ensue, during which he seemed incapable of filling his lungs, as if the air was drawn through a too narrow passage.

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This stage of the disease was attended with a very great and sudden prostration of strength; a very remarkable hollow dry cough; and a peculiar change in the tone of the voice; not easily described, but so singular, that a person who had once heard it, could almost certainly know the disease again by hearing the patient cough or speak. In some the voice was almost entirely lost, and would continue very weak and low for several weeks after recovery. A constant fever attended this disease, but it was much more remarkable in the night than in the day time; and in some there was a remarkable remission towards morning. The pulse at the wrist was in general quick, soft and fluttering, though not very low, and it was remarkable, that at the same time the pulsations of the heart were rather strong and smart than feeble. The heat was not very great, and the skin was commonly moist.

These symptoms continued for one, two, or three days. By that time it was usual for them to be greatly increased in such as died; and the patients, though commonly somewhat comatous from the beginning, now became much more so; yet even when the disorder was at the worst, they retained their senses, and would give distinct answers, when spoken to; although on being left to themselves, they lay for the most part in a lethargic situation, only raising up now and then to receive their drink. Great restlessness and jactation came on towards the end of the disease, the sick perpetually tossing from one side of the bed to the other, but they were still so far comatous as to appear to be asleep, immediately upon changing their situation or posture. An universal languor and dejection were observed in their countenances; the swelling of the face subsided; a profuse sweat broke out about the head, neck and breast, particularly when asleep; a purging in several came on; the difficulty of breathing increased, so as to be frequently almost entirely obstructed, and the patient died apparently from the suffocation. This commonly happened before the end of the fourth or fifth day; in several within thirty-six hours from the time the difficulty of breathing came on first. One child, however, lived under these circumstances to the eighth day; and the day before he died, his breath and what he expectorated, was somewhat offensive; but this was the

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only instance in which I could discover any thing like a disagreeable smell, either from the breath or expectoration.

OUT of sixteen cases attended with this remarkable suffocation in breathing, seven died; five of them before the fifth day, the other two about the eighth. Of those who recovered, the disease was carried off, in one, by a plentiful salivation, which began on the sixth day; in most of the others, by an expectoration of a viscid mucus.

I DISTINGUISH between the salivation and expectoration, because in one the discharge seemed to come from the salivary glands, and was attended with little or no cough; in the others it manifestly came from the trachea, and was attended with an incessant cough; and I judged the salivation to have been a natural crisis, as the patient had taken but grs. vi of calomel before it came on. Her gums were not inflamed, her teeth were not loose, nor had her breath, or saliva, the smell of persons under a mercurial salivation. In this case the voice, in the space of a few hours, from being pretty strong and loud, became so low as to be with difficulty heard.

ONE of the first families in which this disease appeared was that of Mr. William Waddle of this place. He had seven children in his family, all of whom were taken ill one after another; the four first had the disease as I have just now described, and three of these died; the one who recovered was the instance I mentioned, in which the disease was carried off by a salivation. The other three were the youngest. They had not the difficulty of breathing, but in its stead, very troublesome ulcers behind their ears. These began with a few red pimples, which soon ran together, itched violently, and discharged a great deal of a very sharp ichor, so as to erode the neighbouring parts, and in a few days spread all over the back part of the ear, and down upon the neck. They all had a fever, particularly at night, and one of them had a perpetual tenesmus. This symptom appeared in several who had the difficulty of breathing, but in none to so remarkable a degree as in this child.

AFTER

AFTER this, many other children had similar ulcers behind their ears; and some of them seemed slightly affected with the difficulty of breathing; but it never became alarming while this discharge continued. These ulcers would continue for several weeks, and appeared covered in some places with sloughs, resembling those on the tonsils; and at last grew very painful and uneasy.

In some cases they were attended with swellings of the parotid and sublingual glands, which subsided on the eruptions appearing behind the ears, and discharging freely, and again swelled upon the discharge being checked.

I met with but two instances of any thing like this complaint in adult persons. Both of these were women; and one of them had assisted in laying out two of the children that died of it. At first her symptoms resembled rather an inflammatory angina, but about the third day the tonsils appeared covered with thick sloughs; her pulse was low and feeble; she had a moist skin; a dejection of spirits; and some degree of anxiety, though nothing like the difficult breathing of the children.

The other was a soldier's wife, who for some time, before she perceived any complaint in her throat, laboured under a low fever. Her tonsils were swelled, and entirely covered with sloughs, resembling those of the children; but her breath was more offensive, and she had no suffocation.

I HAVE had an opportunity of examining the nature and seat of this disease, from dissection, in three instances. One was a child of three years old. Her first complaint was an uneasiness in her throat. Upon examining it the tonsils appeared swelled and inflamed, with large white sloughs upon them, the edges of which were remarkably more red than the other parts of the throat. She had no great soreness in her throat, and could swallow with little or no difficulty. She complained of a pain under her left breast; her pulse was quick, soft and fluttering. The heat of her body was not very great, and her skin was moist; her face was swelled; she had a considerable prostration of strength, with a very great difficulty of breathing; a very

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remarkable hollow cough; and a peculiar change in the tone of her voice. The next day her difficulty of breathing was increased, and she drew her breath in the manner before described, as if the air was forced through too narrow a passage, so that she seemed incapable of filling her lungs. She was exceedingly restless, tossing perpetually from side to side, was sensible, and when asked a question, would give a pertinent answer, but otherways she appeared dull and comatous. All these symptoms continued, or rather increased, until the third night, on which she had five or six loose stools, and died early in the morning.

UPON examining the body, which was done on the afternoon of the day she died, I found the fauces, uvula, tonsils, and root of the tongue interspersed with sloughs, which still retained their whitish colour. Upon removing them, the parts underneath appeared rather pale than inflamed. I perceived no putrid smell from them, nor was the corpse in the least offensive. The Oesophagus appeared as in a sound state. The epiglottis was a little inflamed, on its external surface, and on the inner side, together with the inside of the whole larynx, was covered with the same tough white sloughs, as the glands of the fauces. The whole trachea, from the larynx down to its division in the lungs, was lined with an inspissated mucus, in form of a membrane, remarkably tough and firm; which, when it came to the first subdivisions of the trachea, seemed to grow thin and disappear: It was so tough as to require no inconsiderable force to tear it, and came out whole from the trachea, which it left with much ease; and resembled more than any thing, both in thickness and appearance, a sheath of thin shammy leather. The inner membrane of the trachea was slightly inflamed; the lungs too appeared inflamed as in peripneumonic cases; particularly the right lobe, on which there were many large livid spots, though neither rotten or offensive; and the left lobe had small black spots on it, resembling those marks left under the skin by gun powder. Upon cutting into any of the larger spots, which appeared on the right lobe, a bloody sanies issued from them without frothing, whereas upon cutting those parts which appeared sound, a whitish froth, but slightly tinged with blood, followed the knife.

THIS is a faithful history of this complaint, as it appeared in all the cases I have met with.

Dr.

Dr. DOUGLASS, of Boston, in the year 1736, published an account of the first appearance of the disease in this country; from which I find that it put on much more malignant and putrid symptoms at that time, than it has lately been attended with, especially in this city, where diseases of the putrid kind seldom occur; and was so constantly attended with the erysipelatous symptoms, that he terms it an eruptive miliary fever, with an angine ulcusculosa. And even in this place, some of the oldest, and most respectable practitioners, assure me, they have seen, but a few years ago, the same disease of which I am now treating, attended both with the erysipelatous appearances and highly putrid symptoms.

Upon the whole, I am led to conclude that the present disease, as well as other similar diseases, which have made their appearance at different times, and in different places, arose from a particular disposition of the air, or miasmata sui generis; which more or less, according to particular circumstances, generate an acrimony in the humours, and dispose them to putrefaction; and which have a singular tendency to attack the throat and trachea, affecting the mucous glands of these parts, in such a way, as to occasion them to secrete their natural mucus, in greater quantities than is sufficient for the purposes of nature: and which in this particular species, when secreted, is either really of a tougher or more viscid consistence than natural, or is disposed to become so from rest and stagnation.

THE disease I have described, appeared to me to be of an infectious nature, and as all infection must be owing to something received into the body, this, therefore, whatever it is, being drawn in by the breath of a healthy child, irritates the glands of the fauces and trachea, as it passes by them, and brings about a change in their secretions. The infection, however, did not seem in the present case to depend so much on any generally prevailing disposition of the air, as upon effluvia received from the breath of infected persons. This will account why the disorder should go through a whole family, and not affect the next door neighbour; and hence we learn a very useful lesson, namely, to remove all the young children in a family, as soon as any one is taken with the disease, by which caution, I am convinced, many lives have been, and may again be preserved.

I SHALL:

I SHALL now proceed to deliver the method of cure, which was found most successful in the disease, as far as it fell under my own observation. And in the first place, as from all the symptoms related, it is evident that this disorder is not always, and in every stage, attended with any remarkable degree of putrescency; and from the dissections it appears, that an inflammation of the lungs, if not the cause, may at least be the consequence of the distemper, one would imagine that V.S. and evacuations were not totally to be forbid; and accordingly we find Dr. Douglass directing us, that if the fever is high, and the patient is plethoric or accustomed to venesection, to take away some blood, but with discretion: And if the tonsils are much inflamed, with great pain and difficulty in swallowing, to use venesection in the jugulars. And Huxham acknowledges, in the ulcerous sore throats of which he treats, "That there were certainly some of them with a pretty smart fever, that bled at the beginning with advantage, and that he was obliged in several to give Nitre with diaphoretics."

BUT Fothergill speaking of the sore throat distemper, which came under his notice, and which seems to be of a more highly putrid kind, assures us, that although in such cases he has been induced to order bleeding, yet it did not appear to have any advantageous effects; and concludes, that notwithstanding the vehemence of the symptoms, it is proper in general to omit this evacuation; nor can I hear of any person who has used it, in the sore throat (which appeared lately amongst us) with success; so that I hardly dare venture to prescribe it, but must leave it to the discretion of the Physician, untill farther experience shall confirm its utility, or forbid its use.

THERE is something very singular in the tendency of the virus in this disease, as I have already hinted, to attack the throat and trachea, nor are the effects it produces there less remarkable. Dr. Fothergill, in his account of the putrid sore throat, describes the sloughs on the tonsils, as mortified escars; but in that species of sore throat I met with, they appeared as, in the trachea, to be nothing more than the mucus of the part, preternaturally thickened into the form of a membrane. At first I imagined this to be only a peculiar kind of pus,

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which is sometimes found upon the surface of internal inflamed membranes; but upon removing it, the membrane of the trachea did not appear to have been sufficiently inflamed, to justify such an opinion. And in a case I lately had an opportunity of examining, where the patient died of a very violent inflammation of the internal membrane of the trachea, there was no such mucous lining to be discovered upon it. Nor can I think it the effect of any spasm or constriction of the lungs, as I never knew it remarked as occurring in such as have died of spasmodic asthma, nor is it long since I had an opportunity of being satisfied as to this particular, in the case of a sailor, who actually died in a violent fit of a spasmodic asthma, which had lasted for several days; and yet there was not the least appearance of any such mucous membrane after death, either in the large or smaller branches of the trachea. This morbid appearance is particularly noticed by several gentlemen who have favoured us with an account of the dissections of those who have died under an angina*. Dr. Monro, sen. found it in several he dissected, and § Rolandus Martin, Professor of Anatomy at Stockholm, mentions a very remarkable instance of it, where this mucous membrane descended into the minutest branches of the tracheal arteria, growing thinner as it descended deeper into the lungs, untill it resembled the membrane which lines the shell of an egg. He adds, that the lungs were not inflamed, nor in the least injured, so that the infant died merely from the suffocation. And even those who have written of the ulcerous sore throat, as Drs. Huxham, and Douglass, and have not given the appearances from dissection, yet have mentioned many mucous linings being expectorated, which Douglass compares to the cuticle raised by vesications, and Huxham conceived, to be really pieces of the internal membrane of the trachea. So that this is a circumstance which seems to be peculiar to the disease; and I believe those who die, on the second or third day, with the strangulated breathing, are generally suffocated, by this membrane. The affection, therefore, of the mucous glands, must be considered as the proximate cause of this disease, and readily accounts for all the other symptoms; and from it only, especially in the beginning of the complaint,

* See Dr. Withering's Thesis on the Angina Gangrenosa.
§ Idem.

can we safely draw our indications of cure, paying at the same time a constant attention to any symptoms of putrescency that may occur.

And it is from viewing the disease in this light only, that we can account for the use of Mercury in it, a medicine, which, if we consider as a spasmodic complaint, cannot possibly have any good effect; or if we look upon it merely as a putrid disease, seems directly contrary to every intention of cure, but which, nevertheless, undoubted experience has proved to be highly beneficial. And indeed, if we consider the peculiar acrimony which this disease occasions in the fluids in general, independant of putrefaction, and the inspissation of the mucus of the trachea, we might reasonably conclude a priori, that Mercury, which in general corrects acrimony in a very remarkable manner, thins all the mucous secretions, particularly those of the mouth and fauces, and affects the breath very early, would be beneficial in it, and either prevent the formation of this membrane, or promote its separation and expulsion, when already formed. Dr. Douglass viewing the matter in this light first tried it, and meeting with success, afterwards recommended it to others; and, in a very few words, has explained both his theory and practice in this particular. "Any affection of the throat (says he) does frequently produce a natural ptyalism. Mercurials used with discretion, are a kind of specific in such like ulcers, and ulcuscula, and in fact here moisten the throat and mouth, stop the spreading of the ulcuscula, and promote the casting off of the sloughs; and as an accessory advantage, the patients being mostly children, destroyed worms. Amongst all the preparations calomel answered best. The gentle vomiting and few stools that it occasioned in some, did not confound the natural course of the distemper. Turbith produces too strong a revulsion, and the eruption is thereby too much diverted. This distemper did not well bate any other evacuation but Mercurials." And in another place, says, "the despumation of this acrid iniquation of the juices in our distemper, that is, its natural crisis, seems to be by the patent and salutary emunctories of the fauces and skin. In corrosive taints, v. g. venereal and others, a Mercurial ptyalism, and sudorific decoction of the woods answer

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“best, this gave us the hint of promoting the tendency of
 “nature in our illness, by mercurials and gentle breathing
 “sweats in bed, which with good management seldom failed,
 “excepting where the necrosis was irremediable from the
 “beginning.”

THERE is a singularity in this Gentleman's stile, but his observations are accurate and judicious ; and, as he says himself, being founded upon real, not imaginary cases, must therefore be of permanent truth. And indeed the case I met with, in which the disorder (and in no trifling degree) was carried off by a very copious salivation, is, of itself, almost a sufficient vindication of this practice ; and together with the case of that child whose body I first opened, where I saw the most powerful antiseptics faithfully administered, which not only failed of success, but did not even mitigate the symptoms, was what first led me to enquire more minutely into the nature of the disease, and of the remedies which had been used with most success in its cure.---Upon reading Dr. Douglass's little essay, (which gave me the greater satisfaction because he wrote upon the disease as it appeared in this country, and under his own immediate observation,) I found he placed his chief dependence upon mercurials, which I was the more readily induced to make trial of, from the appearance I found from dissection, and the idea I thence naturally formed of this complaint ; and the experience I have had of their good effects, fully justifies the recommendation Dr. Douglass has given of them ; as the more freely I have used them, the better effects I have seen from them. Calomel is what I have commonly used, and have given it to the quantity of 30 or 40 grains, in five or six days, to a child of three or four years old ; not only without any ill effects, but to the manifest advantage of my patient ; relieving the difficulty of breathing, and promoting the casting off the sloughs, beyond any other medicine. That it may more immediately enter the blood, and act more powerfully as an attenuant, it should at first be joined with a mild opiate ; and what is a little remarkable, is, that given in this way, it seldom or never raised in children any salivation, tho' indeed I should be apprehensive of no ill consequences from it, if it should. After the first or

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second dose, the opiate should be omitted, as then the mercury will not be so apt to go off by the intestines, and the opiate if continued will, by lessening the sensibility of the trachea, counteract in some measure the attenuating effects of the calomel, and also increase the coma. The operation of the calomel, as an expectorant, will be very much promoted by a prudent use of oxymel of squills, or least that should purge, by ipecacuhana, given so as to puke two or three times.

BUT although I consider mercury as the basis of the cure, especially in the beginning of this disease, I by no means intend to condemn, or omit the use of proper alexipharmics and antileptics; of which the serpentaria, contrayerva, and peruvian bark are the most powerful, and have been used with the greatest success. Sweating is certainly one way, by which nature carries off this disease; insomuch that Huxham declares he did not remember to have had one patient miscarry, who fell into a soft, easy, universal sweat: and therefore, whatever method of cure was pursued, this should be always connected with it. The patient should be kept in bed, and as the disease has a putrid tendency, the diaphoretics should be of the alexipharmic and antiseptic kinds. The bark is certainly a most powerful antiseptic, and when the symptoms of putrefaction, such as a moist clammy skin, highly putrid breath, and hæmorrhages appear, must be attended with advantage. But early in the disease, while the skin continues dry, attended with a great difficulty of breathing, and the symptoms of inflammation rather than those of putrefaction prevail, it should be omitted; and here the removal of the disorder should be attempted, chiefly, by mercurials and mild sudorifics. And indeed I think the whole art, in the cure of this disease, depends upon properly timing these remedies, and insisting upon one or the other, as the symptoms of putrefaction do, more or less, prevail.

BUT besides a salivation; and sweating, nature frequently carries off this disease by an eruption on the skin, ulcers behind the ears, or in other parts of the body, or an external swelling of the throat, all of which seem evidently to indicate the use of blisters. And accordingly Drs. Fothergill and Huxham recommended.

commended them; particularly Dr. Huxham, who says he has sometimes blistered the throat from ear to ear with great success. It has indeed been said, that they sometimes produced mortifications, and that even the discharge they occasioned, seemed to be more than the patient could bear; but as I have never heard this remark confirmed, I cannot help imagining, that the cases in which they were tried, were particularly unfavourable, and more remarkably putrid than is usual; for in the child, who died on the eighth day, I applied blisters behind the ears, and they had not the least appearance of mortification or gangrene, even after the child's death. And in a case of very great danger, which I lately met with, they were certainly of great service, and very effectually supplied the place of those natural discharges, by which nature carries off this disease.

I would recommend their application early in the disease, from the same principle that they are applied in inflammatory angina's or pleurisies; to relieve the throat and trachea, and to derive the flow of humours from the internal, to the external parts.

As the case to which I refer was a very remarkable one, in which the disease was attended with some of the worst symptoms I ever saw, and the method I have been advising was strictly pursued, and attended with success, I cannot help considering this success to be in some measure a proof of the propriety of the treatment, and for that reason shall here insert the case at large.

THE patient was a child of about two years and a half old, who had complained for about a week of a sore throat and hoarseness. The day before I saw her she had some difficulty of breathing, which on that day was greatly increased, and exactly resembled the breathing of the children whose cases I have before related, when most strangled. Upon examining her throat I found the tonsils swelled, inflamed, and covered with sloughs of a yellowish colour. Her breath was not in the least offensive; her pulse was small and fluttering, and her skin pale and clammy. Two very large blisters were immediately applied, one behind each ear, so as to meet at her

throat. She took four grains of calomel, with a quarter of a grain of opium, and was directed to drink a decoction of serpentar : virg : disguised with old metheglin, as a common drink ; and as her skin was pale and clammy, she had a clyster of one drachm of cort. peruv. and ten grains of serpent. virgin. in milk, to be administered every six or eight hours ; but of these she received but one that night ; and as we found she did not retain them, they were soon discontinued ; nor could she be prevailed on to drink but very little of the decoction.

I saw her several times during the first day, and she appeared worse at each time. About eight that evening she had something like a fit ; and, at nine, the strangulation in her breathing was much increased ; her pulse was sunk ; her countenance changed ; her nose appeared to be pinched up ; her eyes were fixed and glassy ; a blue ring was observable about her mouth, and she was comatous. I left her, expecting she would soon die. Her blisters had been dressed a little before ; had risen well ; and discharged freely ; and, within two or three hours, as I was informed by the watches who sat up with her, she seemed to revive. The next morning I was greatly surprised, not only to find her living, but in a sitting posture, eating her breakfast, with little or no difficulty of breathing, having her natural countenance returned, with some colour in her cheeks, and her pulse rather risen. At twelve o'clock however her breathing grew more difficult, and though not so strangulated as the day before, was very quick and uneasy. From this time for five days she remained in a very dangerous situation, and gave but little reason to expect her recovery. Her breathing continued quick and laborious, and her voice was almost entirely gone ; her pulse was quick and low ; she sweated profusely, particularly at nights, and constantly lay in her bed in a comatous situation, giving however distinct answers when spoken to. I could discover nothing disagreeable in her breath, though sometimes what she brought up was a little offensive. During this time, and for many days after, the blisters discharged considerably, and the matter of the discharge was so sharp and corrosive as to inflame and erode the skin almost from the chin to the sternum. She constantly took twice a day.

day three grains of calomel ; and, except the first dose, without opium, until she had taken upwards of thirty grains ; and continued the use of the decoction of serpentar: in as large quantities as she could be prevailed on to take it. On the seventh day from the time I first saw her, she began to cough a good deal, with which she expectorated pretty freely, and brought up some very tough mucus. She breathed more freely, opened her eyes and looked about with some sprightliness, and drank a glass or two of wine. From this time she gradually grew better, and by the fifteenth day from the time I saw her, all her symptoms had left her, except great weakness, and so remarkable a hoarseness, or rather loss of voice, that it was with great difficulty she could be heard; and a peculiar sensibility of the larynx with regard to fluids, so that the moment she attempted to drink she fell into a fit of coughing, although she could swallow solid food without difficulty. This however soon left her, but her weakness and lowness of voice continued, a much longer time, so that in two months she could hardly walk alone, or speak in a tone above a whisper.

WHEN ulcers appear behind the ears, or in different parts of the body, they require a particular treatment ; the discharge should be encouraged by frequently washing them with warm milk and water, and poultices of bread and milk be applied to them ; but greasy applications always do harm, as they check the discharge : nor will they bear digestives. I was in some cases, however, after the discharge had continued for a great length of time, obliged to check it, with a very weak solution of Vitriol. alb. which I found answered this intention well ; nor did I ever observe any ill effects from it : But I always used it with great caution, and never ventured on it, untill I had corrected the general virus of the disease, by a previous use of Mercurials. In respect to gargles, I would entirely follow Dr. Fothergill's advice. Fomentations applied to the breast, and fumigations with the steams of some mild aromatic herbs, and warm vinegar, not only give ease, but serve, in some measure, to attenuate the mucus in the trachea ; and by gently stimulating the lungs, raise a slight cough, and promote the expectoration. The treatment of
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any accidental symptoms, after endeavouring to form a just idea of the disease, must be left to the discretion of the Physician.

SUCH are the sentiments, which, from an attentive observation of the symptoms, and progress of this disease, I have entertained of its nature, and most proper treatment, which nothing, but a real desire of contributing to the stock of medical facts, has induced me to offer to the notice of the public; these being the only foundation of a certain and rational practice; and I can answer for the fidelity and candor with which I have related, what are here preserved.

SUBSTANCE of some PAPERS that could not be inserted in their proper Place.

The following account of an Aurora Borealis was received from a Correspondent, at Lancaster, in Pennsylvania, viz.

“**T**HAT about half an hour after seven in the evening of January 5th, 1769, there was seen at that place, a bright crepusculum, rising out of the North; which in about a quarter of an hour extended itself from N. E. to N. W.---The upper part was deeply notched, and rose in one place to the height of near 40° . above the horizon.

“ AT three quarters after eight, it was so light in the Northern hemisphere, that a person, who felt no decay or infirmity of eye-sight, might easily have read a book printed in Double Pica Roman.

“ AT nine o'clock, five columns or pyramids, of a very vivid Red, rose perpendicular to the horizon, in the N. W.---They were unequal in their heights: For, whilst two of them rose almost to the zenith, others did not exceed 45° . They changed colours alternately from a fiery red to a purple; from that to a yellow; from yellow to a flame colour; and then to red again. These changes were so sudden and quick that they affected the sense so strongly as to raise horror.

“ AT a quarter after nine, the columns changed their perpendicular position to an oblique one, and immediately began
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to move towards the West. They soon blended together, and formed a dirty red sky, tinged with yellow.

“ N. B. THERE were no streamers, corruscations, tremulous or dancing motions, as are common to such Phenomena. This was a quiet one, except that it changed colours, and moved towards the West, as already described.

“ DURING the appearance the air was uncommonly severe and chilling; and, though the Heavens were serene and bespangled with stars, the atmosphere felt damp and heavy.

“ A little before ten o'clock, the whole sunk below our horizon and disappeared.”

Mr. Thomas Gilpin hath presented a model of a Horizontal Wind-mill; and writes to the Society as follows.

“ **T**HAT to obviate the difficulty of turning the house, or frame, of common wind-mills to the wind, he had contrived a model of a horizontal wind-mill, which he had fixed to three pumps, as he apprehended the chief use of such a mill would be the applying it to raise water out of mines and quarries, and likewise out of wells, or brooks for watering meadows. He thinks also it might be further applied to answer the various uses of other wind-mills, without the inconvenience in turning or shifting them as the winds shift.

“ THE model is three pumps erect, in a triangular position; in the center is a crank erect in a step, and steddied by a neck in a frame, from the ears of the pumps; on the top of the crank are eight arms, and at the ends of each is a sail which alternately draws with the wind, and folds against it, which gives a powerful motion to the crank, which, by a handle to each pump, works them in a regular succession.”

Mr. John Jones, of Indian River, Worcester County, Maryland, gives the following account of a Species of Grape Vines, which he had discovered, different from all others he had ever seen.---

“ **T**HE bark (he says,) is of a grey colour, very smooth, and the wood of a firm texture. They delight in a high sandy soil.

foil; but will thrive very well in the Cyprus swamps. The leaf is very much like that of the English grape vine, such as is propagated in the gardens near Philadelphia for table use.

“ THE grape is much larger than the English, of an oval shape, and, when quite ripe, is black, adorned with a number of pale red specks, which, on handling, rub off. The pulp is a little like the Fox-grape; but in taste more delicious. These grapes are ripe in October, and yield an incredible quantity of juice, which, with proper management, he doubts not, would make a valuable wine.

“ HE employed a person to gather about three bushels and one peck of them when ripe, and immediately had them pressed; which, to his surprise, yielded twelve gallons of pure juice, though a good quantity must have been lost in the pressing.

“ IN about twelve hours after putting the juice in a keg, it began to ferment, and he suffered it to go on till it got to be so violent, that it might be heard all over a large room. It continued in that state for three days. He then check'd it, fearing it might turn acid, though, he says, he was afterwards convinced that if he had suffered it to ferment as long again, it would have separated the vinous parts from the fleshy, and given greater fineness to the liquor.

“ AFTER this it was rack'd off, and before cold weather buried in the garden, the top about six inches under ground; where having continued till the summer following, he could not discover that it had in the least altered, either in taste or colour. He observes farther that, after eating a quantity of them, or drinking the juice, they leave an astringency, as claret is apt to do.

“ THERE is an immense quantity of these vines growing on the beach, open to the sea; and they are also found in great plenty upon the ridges, and in the swamps. Since their discovery he has transplanted a number of them into his vineyard, from which, in a year or two more, he expects to make a wine much better than is commonly imported.”

END OF THE FIRST VOLUME.

